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AN ANALYSIS OF THE HUMAN/COMPUTER INTERFACE OF THE PROGRAM MANAGER SUPPORT SYSTEM: CAPPS AND GAT

THESIS

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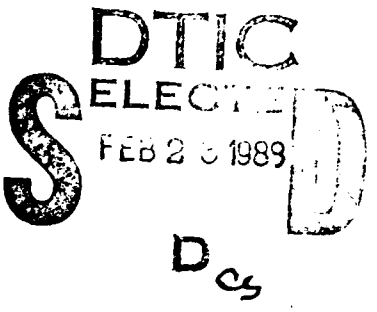

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THESIS

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Abstract

This research reviewed and validated important requirements for the design of an effective human/computer interface. The requirements were derived from expert opinion found in literature and then many of the requirements were validated by protocol analysis.

Fourteen participants, all ASD personnel, tried working scenarios using two modules of the Program Manager's Support System. Their comments were collected, as was an opinion scale, and the data was analyzed.

The participants' comments and opinions followed closely with that of the experts in the literature. This study should benefit ASD in their evaluation of this system and it should provide the system developers ideas for program enhancement.

AN ANALYSIS OF THE HUMAN/COMPUTER INTERFACE OF THE PROGRAM MANAGER SUPPORT SYSTEM: CAPPS AND GAT

I. Introduction

In the last decade there has been a great awakening in the development and use of personal computers. In business, government, schools, and homes across the United States, computers are now a major tool used for word processing, data base applications, financial applications, education, and a myriad of other uses. In the technological rush to develop computers and software to present day standards, designers often forget an important aspect: the human-computer (H/C) interface.

The subject of this research, the H/C interface, has recently become an interest to software designers and computer professionals. They have begun to realize that this interface has been neglected in the past, causing user frustration as well as expensive computer programs and systems to go idle or to not operate at their full potential.

What is an optimal H/C interface? What factors influence the H/C interface? Is there an interface that will satisfy all users? Human behavior is very complex, and there are no simple answers to these questions. This thesis represents an attempt to analyze the building blocks of H/C interfaces and

to evaluate the interface used in a current government decision support system.

Definitions

Merriam Webster's Dictionary defines the term interface as "the place at which two independent systems meet and act on or communicate with each other" (Webster, 1974:373). The H/C interface must then deal with the communication aspects that occur when humans use computers.

The H/C interface adds several other dimensions to the picture. Speaking from the human side of the H/C interface, Rubinstein and Hersh describe "human interface" as "anything the user sees, touches, or otherwise senses and interacts with in a computer or any other system (Rubinstein and Hersh, 1985:234). Edmonds suggests "the interface is that part of the system that represents the user's model of it" (Edmonds, 1982:231). Clarke views the H/C interface as a "joining of perceptual and physical characteristics of humans with the operational, functional, and organizational features of computers" (Clarke, 1986:504,508).

As one can easily note, there is no catch all definition of the H/C interface. For certain it involves the user's senses, perception, cognitive thinking or models, productivity, and decision making patterns. For simplicity, I choose to use the definition proposed by Rubinstein and Hersh.

The terms human factors and ergonomics are described by Rubinstein, Hersh, and Martin as meaning the same thing: the study of how people and machines interact. This involves analyzing those factors that affect the welfare, satisfaction, and performance of people working with man-made systems and equipment, the technology for creating designs that work well in human terms, or factors that go into the design of the H/C interface to make systems more effective and to save redesign costs (Rubinstein and Hersh, 1985:5-7; Martin, 1987:6).

Simpson states the term "User Friendliness" is used indiscriminately by users to describe something about a program that they like. He defines user friendliness operationally in programs as "a program with features that acknowledge human factors." In general the program will be easy to use, tolerant of user errors, and relatively easy to learn (Simpson, 1985:2).

Research Project

Aeronautical Systems Division (ASD), a part of Air Force Systems Command, is looking for software to use as decision making tools for their program managers. They are currently evaluating the Program Manager's Support System (PMSS), a system developed by the Defense Systems Management College, for possible use at ASD. This research will aid in that evaluation by analyzing the H/C interface of two modules of the PMSS. The two modules to be analyzed are the Contract

Appraisal System (CAPPS), version 2.10 and the Government Activity Tasking (GAT) module, version 1.0.

The CAPPS module was designed to help program managers and their staff determine, quantify, and track the status of defense contracts. CAPPS uses Contractor Performance Measurement guidelines to provide this information from a built-in database. The module also can be used on a variety of Air Force microcomputers in a variety of modes, depending on the available hardware and user preference.

The GAT module was designed to help managers track constrained financial and time resources in government activities. The module uses milestones derived from a user supported database.

Research Objectives

The purpose of this research is to determine the requirements for an effective human-computer interface, to evaluate the H/C interface of two modules of the PMSS, and to suggest possible H/C interface improvements for the PMSS. These objectives can be achieved by accomplishing the following sub-objectives:

(1) Define the requirements for an effective human/computer interface from expert consensus found in the current literature.

(2) Evaluate the effectiveness of the PMSS human-computer interface through protocol analysis and interviewing techniques.

Scope and Limitations

Software. This research is limited to analyzing the H/C interface for two of eighteen current and future modules of

the PMSS. Other concurrent research will cover two more modules, thus analyzing four of six available modules.

Research Goals. The primary purpose of this research is to study the H/C interface. Therefore, no attempts will be made to insure the usefulness of the PMSS software on the job. ASD is examining the technical aspects of the usefulness of the PMSS separately. There will also be no analysis of hardware other than what is needed to perform the H/C interface analysis.

Thesis Overview

Chapter two of this study will include the literature review. The research methodology will be explained in chapter three, followed by a description of the results of the study in chapter four. The final chapter includes conclusions and recommendations offered by the researcher.

II. Literature Review

Introduction

This literature review covers the following areas of concern: general guidelines, user classification, error handling, display issues, documentation, interaction styles, response time, and data entry.

General Issues of the Human/Computer Interface and Dialog Design

Before detailing each aspect of the H/C interface and dialog design, there are some general guidelines that are worthy of review. First, Shneiderman identifies "Eight Golden Rules Of Dialog Design" as follows (Shneiderman, 1987:61-62):

1. Strive for consistency in sequences of actions. This includes terminology used in prompts, commands, help screens, and menus. Exceptions should be easy to understand and very limited in number.

2. Enable frequent users to use shortcuts. This can be accomplished by using macro facilities, abbreviations, hidden commands, and special keys. There is a tendency to want fewer and faster interactions as the frequency of use increases.

3. Offer informative feedback. For every user action, there should be feedback from the system. Frequent and minor actions should result in modest feedback, and less frequent and major actions should result in more substantial feedback from the system.

4. Design dialogs to yield closure. Action sequences should be organized into groups with a beginning, middle, and end. Feedback then gives a sense of accomplishment and relief and, therefore, signals the user not to worry about contingency plans. This should prepare the user for the next set of actions to undertake.

5. Offer simple error handling. The user should never be able to make a serious mistake by accident. Error correction should be made as simple as possible.

6. Permit easy reversal of actions. This has a tendency to relieve anxiety regarding errors and will encourage the user to explore unfamiliar options.

7. Support an internal locus of control. When users become experienced, they often want to feel in charge of the system with the computer responding to their actions. Tedious data entry actions, surprises from the system, the inability to get desired information from the system, and the inability to produce a wanted action all lead to frustration and dissatisfaction. Users want to be the initiators of actions rather than the responders to actions.

8. Reduce the short term memory load. Because of human information processing limitations, displays should be kept simple, multiple pages should be condensed, and frequent windowing should be reduced. Online help should be provided to help the user with lists of commands and their abbreviations.

Second, Rubinstein and Hersh discuss the general use of human language and conversation rules to design more effective dialogs (Rubinstein and Hersh, 1985:59-77). They believe that when people use language in interacting with machines, they, even though it is not a conscious act, behave as if the rules for human conversation, language, and meaning apply. The system should then be designed to respect the rules of human conversation and language by not appearing to ignore the user when he/she asks for help. The system should provide appropriate responses and appear to be "friendly" by:

1. not interrupting in inappropriate situations,

2. responding with the appropriate amount of information,

3. using language in a consistent manner,

4. teaching by example,

5. and avoiding arbitrary syntax.

The system can also be designed to enhance meaning by using terminology common to the subject as well as the user's native language.

User Classification

People have varied preferences and tastes and this applies to their willingness to use, and how they use computers. Simpson states that any one system will be used by a varied group that ranges widely in sophistication (Simpson, 1982:110). Shneiderman states that a successful H/C interface design depends on "a thorough understanding of the diverse community of users and the tasks that must be accomplished", (Shneiderman, 1987:9).

It is generally found in the literature that generic classifications such as "novice," "expert," "frequent," and "infrequent" are used to describe users. Shneiderman, Davis, and Olson, although using different terms, classify users as to the degree of semantic (application) and syntactic (computer system) knowledge they possess (Shneiderman, 1987:53-55; Davis and Olson, 1985:530-533). Those definitions are as follows:

1. Novice - Someone who has little semantic and syntactic knowledge when first using the system.

2. Experts or Frequent Users - Users that have a great deal of both semantic and syntactic knowledge.

3. Knowledgeable Intermittent User - Someone who has a high level of semantic knowledge and little syntactic knowledge. This class was proposed by Shneiderman alone.

Simpson believes that any attempt to classify users results in great oversimplification, but points out that the attempt must be made in order to understand the user. He also states that users will vary and will change positions based on the following continuum (Simpson, 1985:22-27).

1. Sophisticated Users - This type of user can typically program software. They understand the many software design principles as well as how all the hardware works. These users are not afraid of software and can change software to fit their own needs. Patience in this group is usually short and they will sacrifice user friendliness for the sake of speeding up the program. This classification of users equates to Shneiderman, Davis, and Olson's "expert."

2. Technical Professionals - Users that fall into this classification know little about, have little interest in knowing about, and may not even like computers. They will basically know enough to turn on the computer and get to the opening screen in the program. Users in this group usually do not read the documentation provided with the program and have a tendency to ignore or misunderstand screen prompts. The main interest of this group is accomplishing the technical function, hence the purpose of the program. The concept of user friendliness is very important to this group. This classification equates to the "knowledgeable intermittent" user described by Shneiderman.

3. Naive Users - This type of user knows little about computers as well as little about what the program is designed to do. These users will make every error possible, so they should be guided step by step through the program. This classification is equivalent to the "novice" described by Davis, Olson, and Shneiderman.

4. Skilled Clerks - Users in this class spend a great deal of time with computers. They are very skilled at using application programs, but that comes from practice and they should not be considered as sophisticated users. They are very much interested in speed. This classification might be considered a subclassification of the "expert" proposed by Davis, Olson, and Shneiderman.

Error Handling

Errors impact all users regardless of experience or application. The errors not only have an effect on the application, but on human motivation and productivity. Barber (1979), as reported by Shneiderman, found that professional workers who had jobs that depended heavily on decision making, made errors using the computer from 7% to 46% of the time (Shneiderman, 1987:63). Ledgard and others (1980), again reported by Shneiderman, discovered that when using a text editor, novices made errors in 19% of their commands while experts made errors 10% of the time (Shneiderman, 1987:63).

The following quote from Norman sums up several of the authors' beliefs about errors and the H/C interface.

> "Errors, however, can be serious, both in the sense that they can lead to serious mishap, and in the social sense that they frustrate beginning users. There is little need for most of these errors. Most are system induced, the result of inappropriate system design. In part these errors spring from insensitivity on the part of the designer to the needs and functions of users of all abilities, from novice to expert" (Norman, 1983:254).

Error Causes and Classification. Shneiderman believes that a lack of knowledge, incorrect understanding, and inadvertent slips are what cause most human errors (Shneiderman, 1987:312). Norman agrees and classifies human errors into three categories (Norman, 1983:254-257):

1. Mode error - This occurs when a user starts an action that is appropriate in one mode, but not in that particular one. An example of a mode error would be trying to type text in the command mode while using a text editor.

2. Description error - This happens because different actions have similar descriptions. For example, an upper case letter causes a different action than the same lower case letter.

3. Capture error - This will occur when a sequence the user is performing is similar to another more often used sequence and overlap occurs. For example, the escape key is used to move about from one function to another and a user accidently uses the escape key to try moving to the next page.

Akin and Rao alternatively classify human errors as follows (Akin and Rao, 1985:605-608):

1. Command errors - Errors that are caused by mistyped commands. Those errors can be transpositional, substitution, omitted character, or extra character problems.

2. Grammatical errors of natural language - Problems caused by poor grammar skills.

3. Grammatical errors of system language - Errors caused by the wrong sequence of command, improperly specified keywords, and improper abbreviations.

Error Messages. Given the different types of errors, how should the system respond to the user error? The appropriate system response usually involves an error message.

According to Simpson, error messages should tell the user there has been an error, identify the error, and show the user how to recover from the error (Simpson, 19585:142). Maguire, Martin, Menkus, Simpson, Rubinstein, Hersh, and Shneiderman all recommend the following ways to help the user when it comes to error messages.

1. Be consistent in form, position, and style with all error messages (Menkus, 1983:13; Shneiderman, 1987:61; Simpson, 1982:118).

2. Make the error messages helpful and descriptive as to what the mistake was, where it was made, and how to recover (Simpson, 1982:118).

3. State errors in terms of the application and not the events within the computer (Simpson, 1985:141-143).

4. Error messages should be polite, non-threatening and low-key . A message from the system such as "fatal flaw" or "nonrecoverable ...etc" should not be in the design (Maguire, 1982:247; Martin, 1986:12; Rubinstein and Hersh, 1985:137).

5. Don't blame the user in the message. Try not to assess blame at all. For example, the message "Too many characters" blames the user and would be better stated as "Five characters expected, but eight were found.", (Rubinstein and Hersh, 1985:137).

6. Don't personify the computer by making the computer too talkative and trying to give it a personality (Rubinstein and Hersh, 1985:140).

7. Make error messages appear different from normal messages (Simpson, 1982:118).

8. Make error messages brief and explicit (Rubinstein and Hersh, 1985:137).

9. Use an audio signal to accompany any error message (Menkus, 1983:13).

Error Prevention. Norman suggests several ways to help prevent errors (Norman, 1983:257):

1. Provide feedback as much as possible. If the computer displays the program mode that the user is in, he/she is less likely to use commands designed for other modes.

2. Be careful of similarity of response sequences. Different classes of actions should have dissimilar menu patterns and command sequences. This will help prevent capture and description errors.

3. Make all actions reversible. There are times when an action should not be reversible, such as when a user saves or deletes a file. These occasions should be clear to the user and all other actions should provide the user a way to reverse an action in case of an error.

Menkus states there is no way to eliminate all errors, but suggests standardization of system response messages as the best way to minimize errors (Menkus, 1983:13). He believes standardization is best accomplished by:

1. making each statement short, clear, positive, and encompassing a single idea,
2. making each statement clear and complete in itself, without reference to manuals or other files,
3. using words that have a commonly known meaning and avoiding jargon,
4. using the same words consistently,
5. and minimizing the use of verbs.

Shneiderman describes the following three techniques for reducing errors (Shneiderman, 1987:64-67):

1. Correct Matching Pairs - Programs often use matching pairs of symbols (e.g., parentheses) to note special operations. When the last symbol is left out, an error results. This can be remedied by using the carriage return as universal ending symbol or by showing a need for a closing symbol on the screen until the user complies.
2. Complete Sequences - When a program requires the user to go through a series of steps to complete an action, the user can easily make mistakes. This can be avoided by using a single step to accomplish the whole series.
3. Correct Commands - Often a typographical error or a wrong abbreviation will generate an error message from command line interfaces. Systems that offer automatic command completion after the first few letters can reduce this type of error. Using another interface style such as the menu interface can also reduce command errors.

Simpson suggests a final way that can help reduce disastrous errors. Users who want to quit in the middle of a task may be tempted to interrupt the program or reboot the

system, causing data loss. Data loss can be avoided by allowing the user an escape from any spot in the program (Simpson, 1985:143).

Display Issues

The way information is displayed often determines whether the user will use or understand that information. Two aspects of information display frequently mentioned in the literature are consistency and human information processing limitations. Smith and Mosier emphasize consistency in all forms of information display, because programs that change format midway are often detrimental to user needs (Smith and Mosier, 1984:93).

Smith, Mosier, Davis, and Olson stress consideration of human information processing limitations when designing screens for information display. Too much information on one screen can cause information overload, which can adversely affect decision-making (Smith and Mosier, 1984:93; Davis and Olson, 1985:534).

Rubinstein, Hersh, Smith, Mosier, Davis, Olson, and Shneiderman state that related data should be shown in vertical (columnar) fashion, because vertical display has been shown to be easier to read than horizontal. Text should be left justified and integers right justified with decimal points lined up (Rubinstein and Hersh, 1985:153-174; Smith and Mosier, 1984:93; Davis and Olson, 1985:534-535;

Shneiderman, 1987:70). To avoid confusion and concentration problems, several authors propose the following guidelines for appropriate information display.

1. Only present the data that is needed (Davis and Olson, 1985:534; Shneiderman, 1987:70).
2. Number all pages (Shneiderman, 1987:70).
3. Identify output data (Rubinstein and Hersh, 1985:158).
4. Number from 1 and measure from 0 (Rubinstein and Hersh, 1985:158).
5. Use graphs and charts when possible (Rubinstein and Hersh, 1985:160; Shneiderman, 1987:70).
6. Avoid cluttering the screen (Rubinstein and Hersh, 1985:161).
7. Standardize all abbreviations, formats, and terminology (Shneiderman, 1987:69).
8. Insure information display is compatible with data entry (Davis and Olson, 1985:534; Shneiderman, 1987:70).
9. Separate sub-items with symbols (ie - 6/21/60) (Davis and Olson, 1985:535).
10. Left justify alphanumeric data and right justify integers with decimals lined up (Shneiderman, 1987:69).
11. The user should be able to control the data display (Shneiderman, 1987:70).
12. Label all information with meaningful labels. Do not break up a label unless necessary (Davis and Olson, 1985:535).

Attention Getting. There are times in an interactive setting when the user needs to be notified of events, including possible errors, feedback as to the completion of an action, impending problems, etc. The way to notify users of these events is through employing attention getting

techniques. Rubinstein, Hersh, and Shneiderman suggest using the subsequent methods (Rubinstein and Hersh, 1985:163; Shneiderman, 1987:71):

1. Change the display intensity for important text or numbers.
2. Use boxes or borders to surround important information.
3. Change font size to emphasize information.
4. Use color or shading to make text or numerals stand out from other displayed information.
5. Use reverse video.
6. Use auditory signals.

It is important to note that overuse of the above methods of attention getting can cause crowded screens and or confusion (Shneiderman, 1987:71).

Using Color. The use of color in computer applications has proliferated greatly in recent times. It is important that color is used correctly to enhance the H/C interface. Durrett, Trezona, Rubinstein, Hersh, Davis, Olson, and Shneiderman agree that use of color can be a benefit to the user. They also warn against the misuse of color, which can be very distracting to users (Durrett and Trezona, 1982:50-53; Rubinstein and Hersh, 1985:165-166; Davis and Olson, 1985:546,548; Shneiderman, 1987:336-342).

Davis, Olson, and Shneiderman state that color is useful for processes that involve searching, counting, or identifying (Davis and Olson, 1985:546,548; Shneiderman, 1985:336-342). Shneiderman further states color adds accents

to displays that are uninteresting and colors bring out emotional reactions in users (Shneiderman, 1987:342).

According to Durrett and Trezona, "Color vision is a complex process of three interacting variables: hue, brightness, and saturation." Hue is the color, brightness is the intensity of light reaching the retina portion of the eye, and saturation is the interaction of hue and brightness. They state contrast, the brightness of the text or numbers over the background, and environmental lighting are important in affecting screen contrast (Durrett and Trezona, 1982:50-53).

Durrett, Trezona, and Shneiderman give the following guidelines for using color:

1. Avoid red/green, blue/yellow, green/blue, and red/blue pairing (Durrett and Trezona, 1982:51; Shneiderman, 1987:341).

2. The use of high saturation colors is limited on less expensive screens, so use the primary hues of red, green, and blue (Durrett and Trezona, 1982:51).

3. Limit the number of colors used to four unless experienced users prevail, and then use a maximum of seven (Durrett and Trezona, 1982:51; Shneiderman, 1987:338).

4. Only use red and green colors for text and numerals when the locations won't be on the edge of the screen (Durrett and Trezona, 1982:51).

5. Use red and blue when fast user response is needed (Durrett and Trezona, 1982:51).

6. Users often associate items of like color as having a relationship. In screen displays, related items should be the same color (Shneiderman, 1987:340).

7. Color coding should be a part of the system without the user having to make an effort to get the colors online (Shneiderman, 1987:339).

8. The user should be able to turn off the colors (Shneiderman, 1987:339).

9. Be consistent in the use of colors (Shneiderman, 1987:340).

Graphics. Information is not limited to textual situations only, but also entails information of a quantitative nature. Many application programs now use graphics extensively to aid in decision making.

Quantitative information can be displayed in two forms, alphanumerically or graphically. Tullis states graphic formats are superior to narrative formats because user response times were shorter, less training is needed for accuracy, and overall user subjective ratings are higher (Tullis, 1981:547). Simpson states graphic plots are very effective for showing trends and relationships quicker than alphanumeric plots (Simpson, 1985:118).

Shneiderman lists the following possible disadvantages of using graphics (Shneiderman, 1987:200).

1. Users have to learn the meaning of certain components of graphical representation.

2. Graphics can be misleading and cause faulty conclusions (alphanumeric display is more precise).

3. Graphics tend to use a considerable amount of screen space.

Documentation

One of the most important considerations in the design of the H/C interface is the help provided to the user. Nickerson, Rubinstein, Hersh, Houghton, and Shneiderman define documentation to include tutorials (both online and

printed), online help, error messages, and other types of learning aids (Nickerson, 1981:476-477; Rubinstein and Hersh, 1985:94; Houghton, 1987:126-128; Shneiderman, 1987:358-359).

Clement suggests that the role documentation plays varies and depends greatly upon the interface it is describing. The more natural the interface is, the less extensive the documentation will have to be, and vice versa (Clement, 1984:204).

Shneiderman cites numerous studies that show printed documents are superior to online. Printed text is superior in both user reading speed and comprehension. Shneiderman states that despite this, there is a great attraction for placing documentation online (Shneiderman, 1987:359-362).

According to Shneiderman, online documentation offers the following advantages (Shneiderman, 1987:374-376):

1. Information is available whenever the computer is available.
2. Workers do not have to allocate any work space to accommodate bulky manuals.
3. It is faster and cheaper to update online documentation.
4. If electronic indexing is available, it takes less time to find information than it does with printed documentation.
5. A computer screen can show graphics and animation that can explain complex actions.

Shneiderman also warns against the misuse of online documentation and proposes the subsequent possible disadvantages (Shneiderman, 1987:375-376):

1. Online documentation is not as readable as printed material.

2. Screens display less information than a sheet of paper and paging through online documentation can be slow.

3. It can be a burden on short term memory when one has to switch back and forth from work to online documentation.

Interaction Styles

To accomplish any work using computers, there must be an interaction between the user and the computer. There are several ways users can interact with computers to accomplish a purpose. All interaction styles are built upon the necessity for the user to give commands for the computer to accomplish a task. The following interaction styles are the three most common.

Command Interface. It is generally agreed that the command interface is the most common interface style. The command interface found involves the user typing instructions to the computer and the computer carrying out those instructions.

Rubinstein and Hersh claim the command interface is for the "sophisticated" user as opposed to the novice (Rubinstein and Hersh, 1985:113). Shneiderman describes the following advantages of the command interface (Shneiderman, 1987:136-172).

1. Long commands can be abbreviated.

2. One command can initiate several operations.

3. Once learned, the commands are precise, thus making this interface quicker than the others.

4. Commands have an immediate impact on devices.

5. The user is an initiator rather than a responder.

6. Several options are usually associated with each command.

It is generally thought that people who are not computer specialists have difficulty using computers because of the command interface. Nickerson and Maguire state commands have a formal syntax with inflexible limits. Unsophisticated users will expect synonyms to be acceptable and usually they are not (Maguire, 1982:245; Nickerson, 1981:477). Shneiderman proposes the subsequent disadvantages to the command interface style (Shneiderman, 1987:136-172).

1. The user can confuse the syntax of the command language with that of English.

2. Infrequent users have a hard time remembering commands. Frequent users rarely memorize more than a quarter of the commands.

3. Typing errors are easily made and the need to be letter perfect can be frustrating.

4. A wide choice of inputs can be confusing to the novice.

Menu Interface. The second most popular interface style in use is the menu style. According to Rubinstein, Hersh, and Shneiderman, the menu interface is excellent for users that are just beginning or have little knowledge of the system (Rubinstein and Hersh, 1985:113; Shneiderman, 1987:86). Users simply use the arrow keys to reach a selection and the return key is used to initiate the action.

Hollands and Merikle classify menu systems into three categories (Hollands and Merikle, 1987:577-579):

1. randomly organized topics for the menu options,
2. alphabetized topics for menu options,
3. and categorically organized menu options.

They along with Brown, Rubinstein, Hersh, and Shneiderman suggest balancing the category of menuing against who the users of the program will be. They also warn against not considering the user or situation when using these classes of menus (Hollands and Merikle, 1987:579; Brown, 1982:412-418; Rubinstein and Hersh, 1985:119-121; Shneiderman, 1987:86).

Research by Liebelt and others, (1982) and McDonald and others, (1983), as reported by Hollands and Merikle has shown that some users perform better on certain classes of menus (Hollands and Merikle, 1987:577-579). It was found that categorical menuing was the fastest method, and least likely to cause problems for the frequent user. Alphabetical menuing was found to be best for the novice user. Random menuing was found to be the least desirable menuing method. The above authors suggest the following guidelines for using menus (Hollands and Merikle, 1987:577-579):

1. Keep menus short.
2. Label all menus for easy identification.
3. Show the user how he/she arrives at a particular menu by displaying constant position information.

4. Consider the level of user expertise when deciding which type of menuing category to use.

5. Be consistent in the use of titles, instructions, error messages, and status reports.

6. Offer help facilities.

7. Be careful not to use a series of complex menus that will slow down system response time.

Direct Manipulation. This style often involves the use of a pointing device such as a mouse, but it is also prevalent in most spreadsheet programs.

A direct manipulation interface uses objects on a screen and allows the user to directly manipulate them by pointing at them or typing directly into them. The objects represent documents, files, or actions applicable to documents and files. According to Rubinstein and Hersh, direct manipulation is often used in conjunction with the other interface styles (Rubinstein and Hersh, 1985:123).

Rubinstein, Hersh, and Shneiderman state the subsequent advantages of the direct manipulation interface style:

1. Pointing is easier than saying (Rubinstein and Hersh, 1985:122).

2. It helps create literal conceptual models (Rubinstein and Hersh, 1985:121-122).

3. It helps novices learn system functions quickly (Shneiderman, 1987:201).

4. Intermittent users can retain operational knowledge (Shneiderman, 1987:202).

5. Error messages are needed less often (Shneiderman, 1987:202).

6. Users tend to experience less anxiety because the system is more easily understood and actions are more readily reversed (Shneiderman, 1987:202).

7. This interface can instill the user with a sense of control over the system (Shneiderman, 1987:202).

The above authors also point out the following possible disadvantages associated with the direct manipulation style.

1. This type of interface makes substantial demands on a system. More memory, more frequent screen updates, and more central processing requests are a few of these demands (Rubinstein and Hersh, 1985:122-123).

2. Users must learn the "icons", or graphical representations (Shneiderman, 1987:200).

3. This type of interface can be slower for more experienced users, thus causing frustration (Shneiderman, 1987:200).

4. Graphical representations take up extensive screen space (Shneiderman, 1987:200).

Most of the software available today is a mixture of at least two interface styles. Often the different interface styles complement each other and allow for more user diversity in program applications.

Response Time

Another important aspect of the H/C interface that confronts users each time they work with computers is the system response time. Martin (1973), as reported by Maguire, defines response time as "the interval between the operators pressing the last key in the input operation, and the terminal's displaying or typing the first character of the response" (Maguire, 1982:246). According to Davis and Olson, the response time of any particular system is affected by

system capacity, the number of users, and the complexity of user operations (Davis and Olson, 1985:540).

In a survey of over four thousand computer users, the majority of whom used microcomputers, Rushinek and Rushinek found response time as the highest inducer of user satisfaction (Rushinek and Rushinek, 1986:597). Kuhmann and others, showed that different response times affected pulse and blood pressure readings of users. They also showed that error rates went up as the response time went down (Kuhmann and others, 1982:933-940).

Rubinstein and Hersh state "Response is good, adequate, or bad only in terms of the users' perception" (Rubinstein and Hersh, 1985:149). Most authors generally agree that human perception is the key regarding response time. Novices wonder if they have made a mistake if the response takes awhile. Frequent users tire and become upset if they have to wait for responses. Davis and Olson state response time should not be as fast as possible, but should be consistent for a given level of user expertise (Davis and Olson, 1985:540).

Miller (1977), as reported by Maguire, suggests eliminating variability, even if it increases the average response time. He conducted a study that showed users were less satisfied and performed poorly on systems that had high variability in response times (Maguire, 1982:246). Davis, Olson, and Shneiderman, give the following guidelines regarding system response times (Davis and Olson, 1985:540; Shneiderman, 1987:278):

1. When there is no penalty for making errors, users will prefer to work quickly.

2. If the task is easily comprehended, users prefer rapid action.

3. When users have had rapid performance in the past, they will expect it in the future.

4. Long response times should be announced by an interim message.

Data Entry

Data entry constitutes one of the largest parts of computer use and therefore can be a large part of the H/C interface. It must be done before the computer can be used as a decision making tool. Simpson, Rubinstein, Hersh, Davis, Olson, and Shneiderman propose some guidelines regarding data entry or input.

1. Use a prompt or cue and make the cursor automatically move to the next location for input (Davis and Olson, 1985:534; Rubinstein and Hersh, 1985:175; Simpson, 1982:116).

2. The length of the data string entered should be kept at a minimum as to not tax the human short term memory limitation (Shneiderman, 1987:73).

3. Use a screen design patterned after the paper form that the clerk gets the data from (Davis and Olson, 1985:534; Simpson, 1982:116).

4. The user should have the flexibility to enter data however they wish (Rubinstein and Hersh, 1985:174; Shneiderman, 1987:73).

5. Remove any redundant data entry (Simpson, 1985:128).

6. Allow abbreviations in input (Rubinstein and Hersh, 1985:174).

Simpson further suggests the subsequent ways of making data input easier (Simpson, 1987:127-134; Simpson, 1982:116-122):

1. Set limits as to the length of a data entry using a line, a pair of brackets, or some other visual cue.

2. Defaults should be displayed until changed.

3. Feedback should be immediate so the user can see that the data was entered correctly.

4. The operator should control what data is entered as well as when it is entered.

5. Data entry should be self paced.

6. Prompting should be adjustable according to the user's desires.

7. Allow users to change their minds.

8. Provide for instant as well as later error correction.

9. One area of the screen should be used for data entry (unless a form-fill-in screen is being used).

Summary

The concept of the H/C interface is a very complex one. There are a myriad of considerations to be made when designing an interface. There are complex relationships between the mentioned interface factors, the users, and the user's ability to accomplish work with computers.

Shneiderman states that "a well designed system almost disappears, allowing the user to concentrate on their work or pleasure" (Shneiderman, 1987:9). He further states that a well designed H/C interface generates " positive feelings of success, competence, and clarity" with users (23:9). This task is by no means easy and one must consider some complex relationships.

To show some of the many relationships a designer must consider, an analysis of a possible project might be in

order. First, let us consider the user. As previously noted, users are a diverse group with different needs and desires. What kind of users are going to use the program? Is there an interface style or combination of styles that will please all or most of the users?

The answers to the above questions can directly relate to issues concerning: the type of tasks to be performed, the type of equipment needed to run the program, the type of training needed for the users, and the overall expense of the program.

The tasks to be performed determine needs in the areas of information display and input, system response time, error prevention and handling, documentation, and interface styles. For instance, users in a nuclear power plant might need a system that provides: quick response times, display screens that use color and sounds for warnings, extremely neat screens that properly use graphics and other information characters, ways to prevent errors, ways to quickly overcome errors through online and off-line documentation, and precise input techniques. Other types of tasks need other considerations.

If the users already have equipment, there may be limitations as to interface styles, response times, and data display and input. The designer will have to design according to the equipment.

This by no means covers all the H/C interface issues that a designer might face, but hopefully one can see the

complex relationships that are found in H/C interface issues, and much time and care should be put into the design of a program to insure the best H/C interface possible.

III. Methodology

Introduction

This study of the H/C interface of the CAPPS and GAT modules of the PMSS involved the use of protocol analysis and interview techniques. According to Emory, the interview technique has the following inherent strengths (Emory, 1980:294).

1. This method allows data to be collected at the time of occurrence and therefore is not forgotten.
2. Common information is not overlooked or seen as irrelevant.
3. This method allows the researcher to collect more detailed, better quality, and a greater quantity of information.

Ericsson and Simon state some basic assumptions in using the protocol analysis form of research. Those assumptions important to this study are listed below (Ericsson and Simon, 1984:9).

1. Verbal behavior is a type of behavior that can be observed and analyzed like any other behavior.
2. The thinking processes that are behind verbalizations are a subset of the thinking processes that cause any other behavior behavior.
3. A single invalid verbal statement as with other behaviors should not cause the discarding of verbal reports in general.

With the above strengths of interviewing and the assumptions of protocol analysis in mind, this study of the H/C interface of the PMSS should be considered valid because: the information gathered by protocol analysis should be the same

as that gathered by any other method; protocol analysis allows more data to be collected because it lessens the amount forgotten; and the data that is collected should be more detailed and of a better quality.

Limitations

Emory, Ericsson, and Simon have posed some warnings regarding weaknesses, issues, or problems with interviewing and protocol analysis. Emory poses the following weaknesses with interviewing (Emory, 1980:286-288).

1. The setting up and actual data collection is very time consuming.
2. If participants do not easily speak their minds, surface indicators must be used to reach conclusions.

Ericsson and Simon, state the following issues are worthy of thought before embarking into a protocol analysis effort (Ericsson and Simon, 1984:2-6).

1. Some researchers express doubts about verbal data. Some have said it is good for surveys, but it is difficult to objectively measure.
2. Data is hard to extract from behavior. Illegitimate introspection is hard to distinguish from data.
3. Some researchers believe verbal reports are "soft" data rather than "hard". They feel that verbal reports may be more theory than data.

As noted above, this type of research is inherently time consuming. Because of this and time constraints, there were only seven participants involved with each of the modules. Because of this small sample size, all statistics are limited to those of simple summary type.

Besides the above listed assumptions, another assumption was also made that the participants in the study were knowledgeable intermittent users in that they knew the application subject, but knew nothing about how the PMSS works.

Participants

The participants in all the modules were ASD personnel. Participants in military lower management positions were all officers between the ranks of Second Lieutenant and Captain. The lower level managers managed small parts of large programs and supervised few if any personnel. Military middle level managers in this study held the rank of Major, and they tended to manage larger projects and to supervise more people. Civilian engineering personnel were between the grades GS nine through twelve, were involved with ASD projects, and typically did not supervise anyone. Civilian middle managers were between the grades of GS twelve and fourteen; typically their duties were similar to military middle level managers.

All of the participants were involved with providing decision support for upper management. The participants all had experience with Air Force microcomputers, including the Zenith 100, 150, and 248 models. Their experience included applications use with spreadsheets, wordprocessing, and graphics. These applications were used mainly for decision support for themselves and upper level management.

There were four military and three civilian participants using the GAT module, with the military representing lower management and civilian representing clerical help. The remaining civilians were considered engineering staff. The participants using the CAPPS module included four military middle managers, one military lower manager, one civilian middle manager, and one civilian engineer. This participant mixture reasonably represents the ASD users of the PMSS.

Problem-Solving Tasks

A scenario, consisting of several tasks, was developed for the protocol collection for each module (see appendices A and B). The tasks were designed to specifically test each phase of the module so the participants would be exposed to all aspects of the module H/C interface. The scenarios were evaluated by the ASD project officer to insure the content was similar to that which could be found in everyday system program office work.

GAT Module. The scenario for the GAT module told participants they would be changing data for engineering change proposals (ECP's) for a program currently in progress. The information could then be used for progress checking or for making reports. The tasks were designed as shown below.

1. Task 1 - This task involved editing an existing database. It was designed to test editing features (data input and error correction issues), ease of movement, and information display issues.

2. Task 2 - This task was designed to test ease of movement and information display.

3. Task 3 - This task was designed in the same manner as task 1.

CAPPS Module. The scenario for the CAPPS module put participants in the role of a program office staff person working on a fictional new program. Their job involved two things. The first was tracking the progress of the program by changing input data and the second involved making reports for upper management. The tasks were designed as shown below.

1. Task 1 - This task was designed mostly to test information display and movement issues.
2. Task 2 - This task was designed to test the same issues as task 1.
3. Task 3 - Issues concerning error correction, data input, and ease of movement went into the design of this task.
4. Task 4 - This task was designed to test data input and ease of movement.

Participant Preparation

The participants were briefed on a variety of points prior to the protocol collection and interview (see appendix C). The purpose of the briefing was to describe the study, ASD interests regarding the study and the PMSS, to determine participant scheduling and module preferences, and to answer any participant questions.

After scheduling the participants to a particular module, the documentation and scenario were given to them. This was done at least a day and one half before the protocol collection. The participants were instructed to preview the scenario and the documentation. The preview was not to be in

time consuming detail, but was to be done to familiarize the participant with general program capabilities and movement patterns.

Equipment

The PMSS modules were run on a Zenith 248 IBM compatible microcomputer. It was equipped with a color monitor, enhanced graphics adapter, 640k random access memory, a standard IBM keyboard, a 20 megabyte hard drive, and one floppy disk drive.

To aid in the data collection, a voice activated microcassette was used during the protocol collection and interview.

Test Site Layout/Conditions

ASD provided a partitioned office, approximately 12 feet by 12 feet, to conduct the protocol collection and interview. It was surrounded by other offices, of which half were vacant. The office contained two desks, one of which was used for the computer (see appendix D).

During the protocol collection and interview, the background noise was typical of office type work and consisted of muffled voices in other offices and the hallway, ringing telephones in other offices, and the constant noise of the microcomputer fan. The temperature was about 78 degrees F. with the air conditioning provided. The lighting was florescent and provided ample light for reading.

Opinion Scale

The opinion scale consisted of eleven questions taken from "Designing the User Interface" on various issues dealing with the H/C interface (Shneiderman, 1987:400:404). Each question provided participants a scale from zero to six, with zero being the worst rating and six being the best, to best fit their opinions. For more detailed information on the opinion scale, see Appendix G.

Protocol Collection and Interview

Upon arrival, the participants were greeted and made comfortable at the desk with the microcomputer. To start the procedure, the participants were given an overview of what was going to happen during the procedure. They were told the session would include an agreement procedure, followed by a warm-up game, the module scenario session, an opinion scale session, and a five question wrap-up. The detailed procedure is listed below.

1. The participants were given a statement of agreement with the researcher's signature to emphasize their anonymity and to encourage them to voice their opinions (see appendix E).

2. The participants were then introduced to a computer game as a warm-up to the computer and the protocol collection procedure. The instructions for play and the interface issues to look for were explained to each participant. For a detailed description of the game and the questions asked, see Appendix F.

3. The participants were then instructed to load the particular PMSS module being tested and to begin working the scenario. They were encouraged to voice opinions about any part of the program and to feel free to use the documentation provided.

4. If during the protocol collection a participant appeared puzzled or commented in a voice that the recorder could not pick up, they were asked to repeat or tell what they liked or disliked about that particular part of the program module. The researcher was also taking notes during the entire process.

5. At the conclusion of the scenario, the participants were given a subjective rating scale (see appendix G). They were given instructions on how to fill out the form and were told to feel free to make added comments by either writing them down or voicing them.

6. The participants were then asked some summary questions to provide details as to their experience with computers and the usefulness of the module in relationship to their current or past jobs. The questions can be found in Appendix H.

IV. Analysis and Results

Introduction

At the conclusion of the protocol analysis and data gathering portion of the this research, the data was analyzed. A microcomputer statistics package, called Interactive Statistical Programs, was used to calculate the summary statistics from the participant opinion scale (see appendices I and J). All oral participant comments were transcribed from tape and filtered to remove comments that did not relate to the issues at hand. The transcribed comments (see Appendices K and L) are organized by the task structure given in the participant scenarios.

Participant comments on the two PMSS modules will be analyzed separately using the major areas of the H/C interface listed in the literature review as a guide. The order of topics in the literature review will also be the order by which the topics will be covered in this chapter except that only those interface areas employed in each module and commented upon by the participants will be included. Those areas of the H/C interface that do not appear to fit under one of the specific classifications will be discussed in the general issues section, which includes Shneiderman's "Eight Golden Rules of Dialog Design." Comments that do not easily fit into one of those design issues will be discussed in a miscellaneous section.

The results (ie - frequency distribution and high to low ratings) from each question in the participant opinion scale

will be illustrated throughout the chapter. The mean on a scale of seven and standard deviation from each question will also be identified. It is important to note that questions in the opinion scale regarding online help and graphics only apply to the CAPPS module.

GAT Results

General Issues

Ease of Movement. Five of the seven participants made comments regarding the ease of movement in the GAT module. The majority of the comments dealt with the use of arrow keys for movement within the program. Some comments concerning the use of the space bar dealt more with display issues and will be discussed in that section.

One participant suggested using the tab key to shift from field to field. Three participants suggested the program would be more efficient if changed to allow the use of all four arrow keys throughout the program for scrolling up and down as well as side to side. One participant expressed no preference for the use of right/left or all arrow keys, but did suggest making the program consistent one way or the other. This participant's opinion is in agreement with the literature (Shneiderman, 1987:61). The literature does not specify any technique as the best, but it does support the need to use one technique consistently.

One question in the opinion scale concerned the ease of movement throughout the module. The mean participant rating

in this area was 4.57 with a standard deviation of 1.9. Figure 1 details opinion scale results.

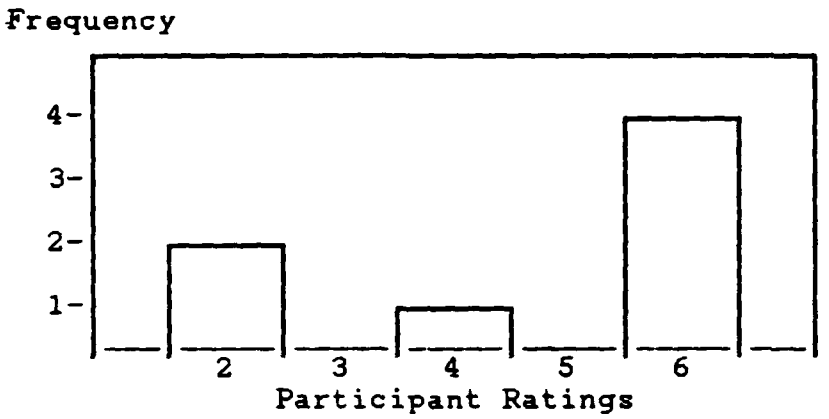


Fig. 1. GAT Ease of Movement Histogram

Consistency in Sequences of Actions. Disregarding the comment about consistency in arrow key use already discussed, this issue surfaced in the comments of another participant. The participant commented that when trying to save a report format, he tried to exit first, which was inappropriate at the time. The participant stated that he was programmed to exit before saving because that is the way it was done earlier in the program in a similar situation. According to the literature, it should be no surprise that a participant had a problem at this point. The sequences of actions were not consistent; therefore, problems can occur (Shneiderman, 1987:61).

Offer Informative Feedback. The opinion scale questioned participants about the clarity of the GAT module system messages. The mean participant rating was 4.28 with a

standard deviation of 1.38. Figure 2 details the range and distribution of these ratings.

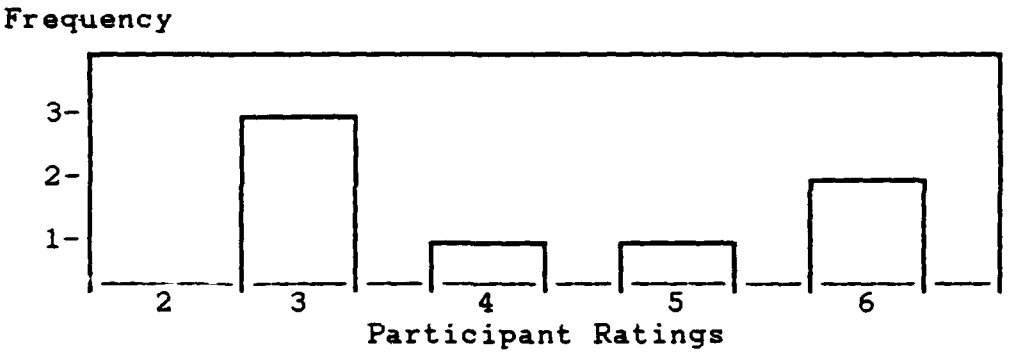


Fig. 2. GAT System Messages Histogram

Error Handling. Most of the comments in this area were very closely related to the design of the screen display and will be discussed along with screen display issues. The only exception was a comment by one participant, who stated you had to realize where you were (ie, which screen was being displayed) to be able to correct errors effectively.

The ability to correct errors was the topic of another question in the opinion scale. The mean participant rating was 4.28 with a standard deviation of 1.49. Figure 3 further details participant ratings regarding error correction.

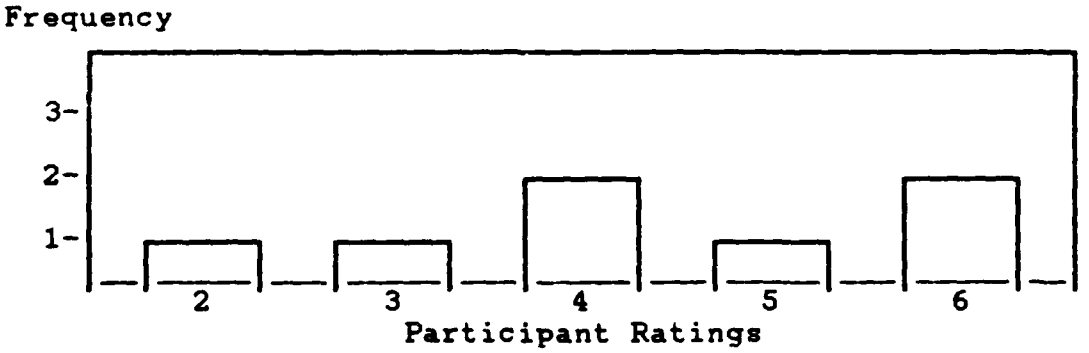


Fig. 3. GAT Error Correction Histogram

Display Issues

Color. Five participants stated opinions about the use of color in the program. Three participants said they preferred using the default colors of white or grey on a background of dark blue. Two of those three participants stated a preference for light blue writing over the grey or white on the default dark blue background, although the program was not bad with the default white that turns grey when entered. One participant stated that the program should have provided more color options because the equipment could support more of a variety. Once again, the GAT module does not offer something that is available in many application programs. This makes the GAT module inconsistent with what is already available for use. It is also important to note that one participant said that he did like the options available.

Another opinion scale question rated how the colors used affected contrast. The mean participant rating was 5.14 with a standard deviation of .89. Figure 4 describes participant responses for the quality of GAT color contrast.

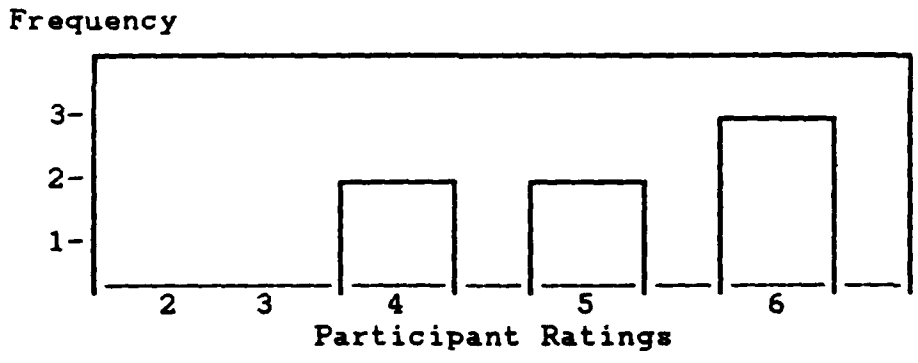


Fig. 4. GAT Contrast Histogram

The general use of color was the topic of another question in the opinion scale. The mean participant rating for the overall use of color was 5.43 with a standard deviation of .79. For the distribution of participant ratings and the highest to lowest ratings, refer to Figure 5.

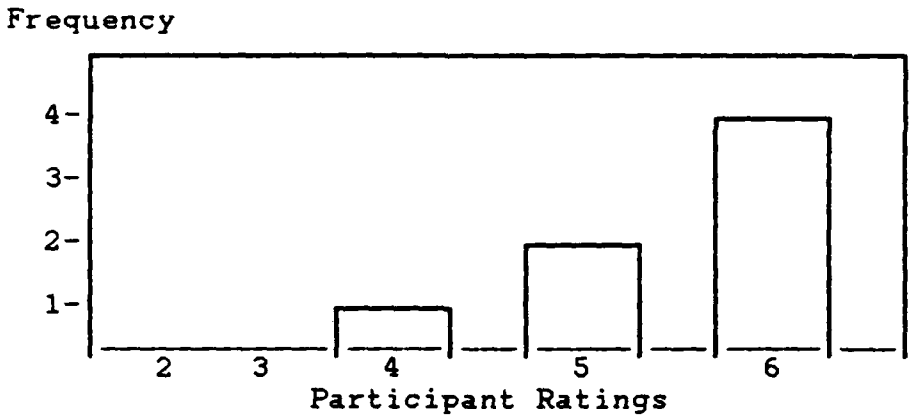


Fig. 5. GAT Overall Use of Color Histogram

Screen Layout. Four participants made comments regarding the layout of information presented. Three participants did not care for the header listing order and suggested the headers in the report generator (see Figure 6) be listed in alphabetical order to avoid confusion and help users find the needed headers more quickly. These opinions are in agreement with the literature. Since the header option display is essentially a menu, research has shown alphabetical organization to be more effective than random ordering (Hollands and Merikle, 1987:578).

Two participants expressed some concern over the headers in the report generator being too large for the display box. Because the field size of some of the headers was too large to be fully displayed, the participants were concerned over

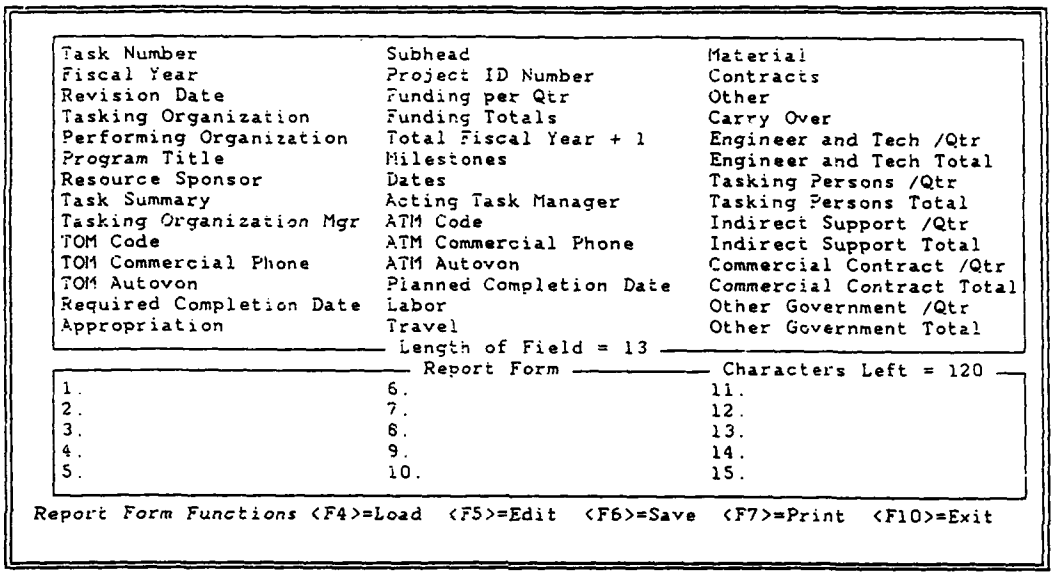


Fig. 6. GAT Header Listing Order

the quality of the printed report. According to the literature, consistency should be emphasized when it comes to information display (Smith and Mosier, 1984:93). It should then be no surprise that headers displayed one way at the top of the screen and another at the bottom could cause problems.

While editing numbers, one participant said the program ought to act like a calculator by starting on the right edge and forcing the number out as it goes. This participant is also in agreement with the literature (Shneiderman, 1987:69).

Two other participants commented that they would prefer leaving information in subject fields and changing only that which needed change, instead of reentering all of the information in a field. These comments agree with the literature in two ways. First of all, redundant data entry should be avoided (Simpson, 1985:128). Although part of the data needed editing, most of it was correct; therefore, typing it again is redundant. Secondly, users should have flexibility in how they enter data (Rubinstein and Hersh, 1985:174; Shneiderman, 1987:73). The participants have no options while editing in the GAT module.

Two participants also said it was a little strange and confusing having the previous numbers stay in fields during the editing process, rather than blanking the whole field until replacements were entered by striking the "enter" button. The blanking feature is available in some application programs.

One participant commented on the overall screen display other than by a ranking on the opinion scale. The participant stated the screen display was neat and very orderly.

The opinion scale measured what the participants thought of the neatness of the screen layout. The mean participant rating in this area was 5.29 with a standard deviation of .76. The distribution and rating range are shown below in Figure 7.

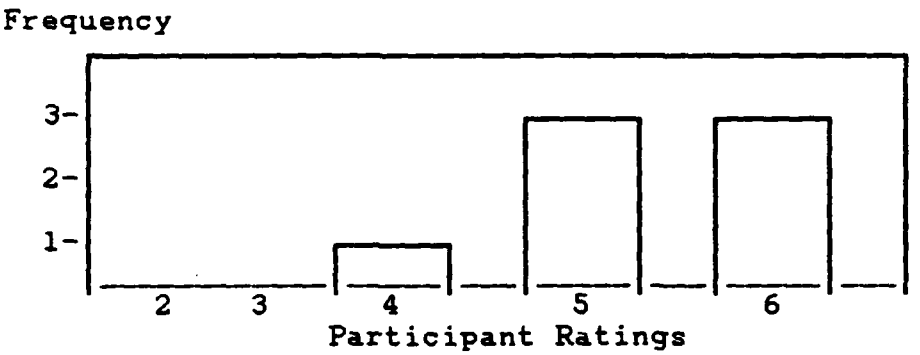


Fig. 7. GAT Screen Display Histogram

Documentation. Besides expressing opinions about the documentation in the opinion scale, three participants contributed more comments. One participant said the documentation was good, but maybe a little too simple. He further added that in some cases simplicity might be the best approach. Another participant stated a liking for the users' manual, especially the step by step approach of what to do, why it needs to be done, and how to do it. Finally, one participant said the documentation was fairly easy to use, in fact much easier than the documentation that comes with Air Force microcomputers. The literature treats written

documentation as a continuation of the H/C interface and as such, it is required to accommodate all levels of users. The participant that thought the documentation was too simple was an expert and he realized the documentation needed to be simple to aid the other classes of users.

Two questions in the opinion scale dealt with documentation issues. One covered the overall layout and how easy it was to use and the other covered the participants overall opinion of the helpfulness of the written documentation. The mean participant rating of the layout was 4.72 with a standard deviation of 1.38. Figure 8 shows the frequency distribution of participant ratings.

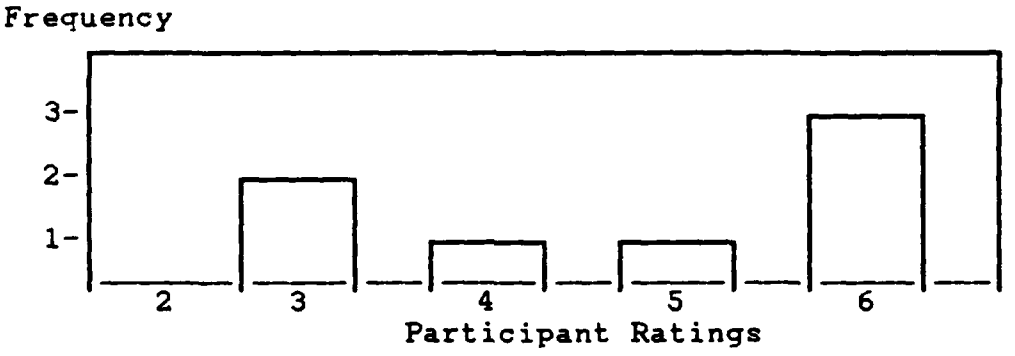


Fig. 8. GAT Written Documentation Layout Histogram

The mean participant rating concerning overall opinions about the written documentation was 5.14 with a standard deviation of .69. Figure 9 details the range and distribution of those ratings.

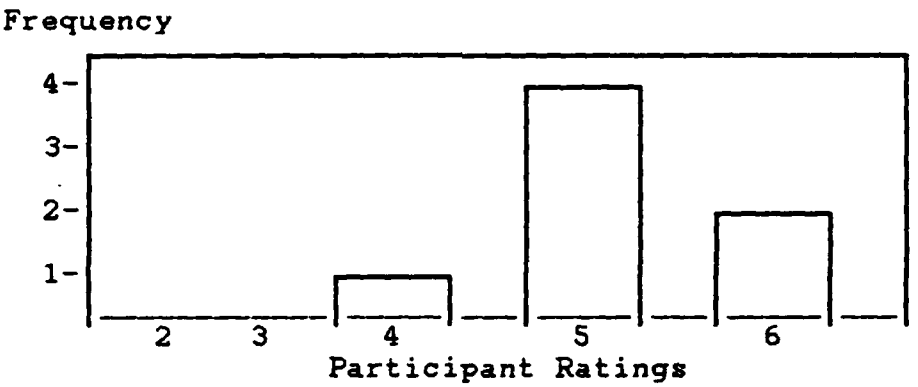


Fig. 9. GAT Overall Written Documentation Histogram

Response Time. Two participants made comments about the system response time. Both said the response time was excellent, especially since a floppy disk drive was used instead of a hard drive. The literature suggests response time is good or bad only in terms of the users' perception (Rubinstein and Hersh, 1985:149). Since the participants did rate response time as favorable, the response time is appropriate.

The opinion scale rated the participants' opinions on the system time used in response to user commands. The mean participant rating for response time was 5.43 with a standard deviation of .79. Figure 10 gives more summary statistics.

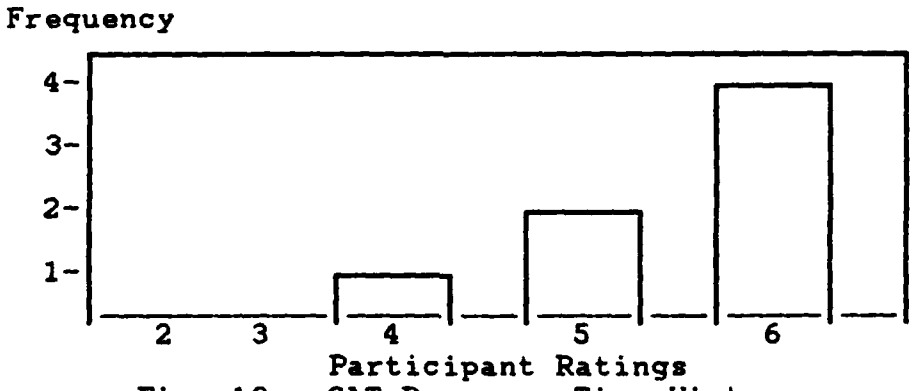


Fig. 10. GAT Response Time Histogram

Data Entry. The comments concerning the editing process discussed with display issues could have also been applicable to data entry issues. There were no questions dealing specifically with data entry on the opinion scale since so little data was entered during the scenario exercises.

CAPPS Results

General Issues

Ease of Movement. The issue of using a space bar instead of arrow keys for general movement also arose in the CAPPS module. Four participants commented on this issue. One participant said he did not like using the space bar and the back space keys to move within the program, but would rather use the arrow keys all of the time. Three participants said nothing was wrong with using the space bar, it was just different from the way other programs handle the movement issue. Two of the three participants suggested some mistakes they made were caused by a lack of consistency in using the space bar or the arrow keys. They suggested the program should be consistent throughout. As with the GAT module, the CAPPS module goes against the literature by disregarding consistency of actions.

Two participants suggested there should always be an option in the CAPPS menu system of going back to the previous page. Although they were the only participants to suggest this, they were also the only ones to accidently go one screen too far while trying to accomplish tasks. The literature agrees with these comments and suggests actions

that are easily reversed can lessen user anxiety about errors as well as encourage users to explore the unfamiliar (Shneiderman, 1987:62).

Again, the opinion scale rated the participants' opinions on how easy and time efficient it was to move throughout the CAPPS module. The mean participant rating was 4.2 with a standard deviation of .97. Figure 11 describes the distribution and range of the ratings.

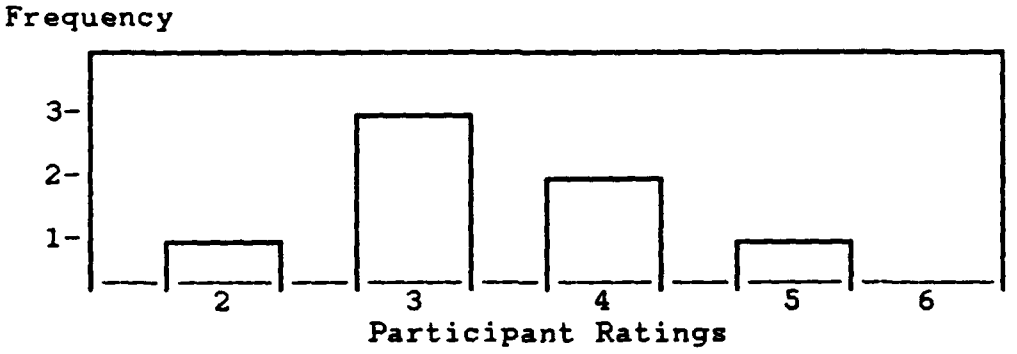


Fig. 11. CAPPS Ease of Movement Histogram

Offer Informative Feedback. System messages are feedback for the user, and one participant commented about a problem in this area. While trying to use the "previous screen" option, the participant stated the system message telling him that he could not go back further was too short in duration. He had to press the button three times to read the full message. The participant had a reason to comment according to the literature. Messages must be displayed long enough to provide meaningful feedback (Simpson, 1982:118). This particular error message should also have been consistent with all of the others (Menkus, 1983:13; Simpson,

1982:118; Shneiderman, 1987:61). Other error messages remain displayed much longer or until the user initiates an action.

The CAPPS module employed system messages throughout the program. The participants rated the messages as to how clear they were. The mean participant rating was 4 with a standard deviation of 1.63. Figure 12 gives the participant rating distribution and range.

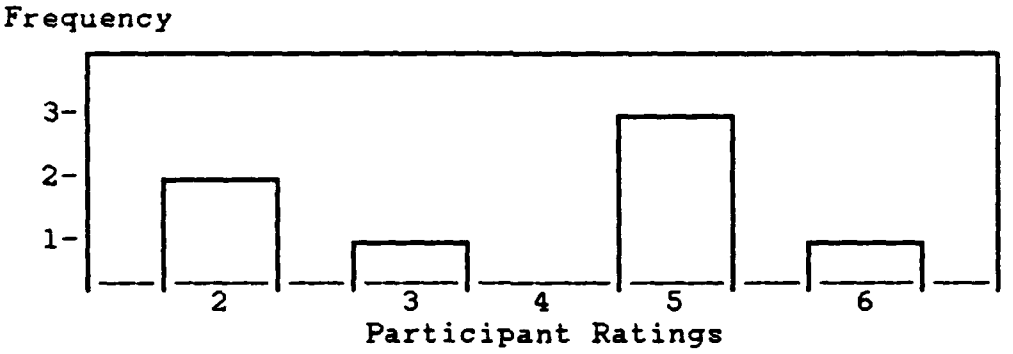


Fig. 12. CAPPS System Message Histogram

Designing Dialogs to Yield Closure. Three participants made comments suggesting confusion about knowing whether a task was complete, and if so, where the program would place them after task completion. Two participants commented about using the "Quit" option found throughout the CAPPS module. One of the participants asked whether the option would get him out of a particular function or if it would end the program. The other participant tried the option to end a function and ended up exiting the whole program.

Three participants near the end of task four, had problems determining if changes had been saved to the database. One participant stated that his work had not been

saved; in reality it had, but it was not shown. The literature is in agreement with all of the participant opinions in this section. Action sequences should have definite starting and ending points so users can get a sense of accomplishment (Shneiderman, 1987:62).

Consistency in Sequences of Actions. Participant comments about consistency, like those with the GAT module, centered around the movement issues and the appropriate keys to use. All comments about consistency were mentioned in the section covering the ease of movement throughout CAPPS.

Error Handling. Aside from the opinion scale, only two participants remarked further about error handling in CAPPS. One participant, although he was not specific, stated having a problem with the general way the program allowed error correction. Another participant said it was a cumbersome process to correct errors and not at all like the programs he frequently used. He further suggested allowing users the ability to page back to aid in error correction. The literature states error correction should be made as simple as possible (Shneiderman, 1987:62). The page back option also suggested would permit easy reversal of actions which could reduce user anxiety about errors (Shneiderman, 1987:62).

One area of concern in error handling is the prevention of catastrophic errors. One participant destroyed the program database because he did not notice the displayed warning that occurs when you begin entering data for a new program. He expressed concern about how easily the database was

destroyed. He also suggested the program should be modified so if a change is made, the old database should be kept for a period of time. This opinion is also in agreement with the literature. For a period of time, all actions should be reversible (Norman, 1983:257). Auditory signals, warning colorations, and highlighted messages can be used to insure a user notices a warning.

The participants rated the CAPPS module on how easy and time efficient it was to correct errors. The mean participant rating was 4.28 with a standard deviation of 1.60. Figure 13 depicts the participant rating range and distribution.

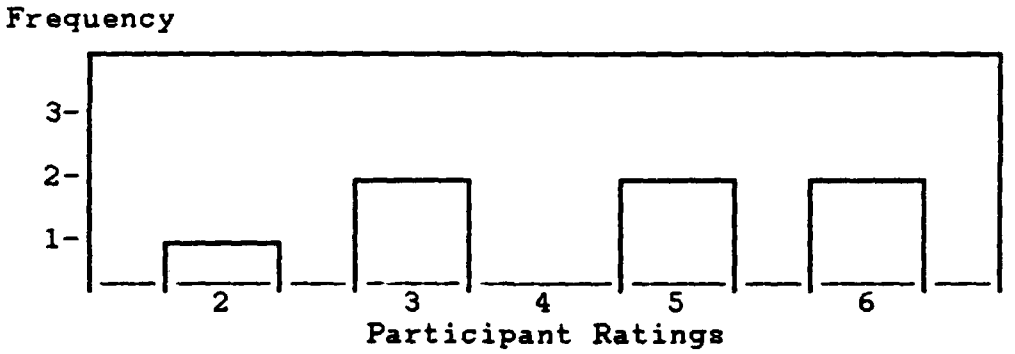


Fig. 13. CAPPS Error Correction Histogram

Display Issues

Using Color for Highlighting. Four participants expressed opinions about the use of color for highlighting or attention grabbing purposes. Three participants said they had difficulty distinguishing menu items from each other. To avoid that type of confusion, they suggested using color to highlight menu items. One participant further stated he would prefer coloring the option associated with the cursor

different from the others in the menu. These opinions are also backed by the literature (Rubinstein and Hersh, 1985:163; Shneiderman, 1987:71). Besides these suggestions, reverse video, the use of borders, varying display intensity, the use of blinking words, and even putting more space between the options, are possible solutions to this problem.

Two participants stated the menu area of the screen (see Figure 14) grabbed their attention more than the title areas. This caused confusion by making the participants think the bracketed menu option was indeed the title. One of the participants suggested using colored titles to remedy this problem. The comments at the end of the previous paragraph also apply in this situation.

Two participants commented that they very much liked the highlighted text areas for warning users of impending project problems. This agrees with the literature as one of the ways highlighting is used effectively.

General Use of Color. In rating the overall use of color for text and background, one opinion was expressed. The participant said users should have color options because white lettering bothered him. He stated a preference for yellow lettering with the dark blue background instead of the white lettering. Again, consistency with other application programs is important. The literature also stresses the importance of letting the user control the colors (Shneiderman, 1987:339).

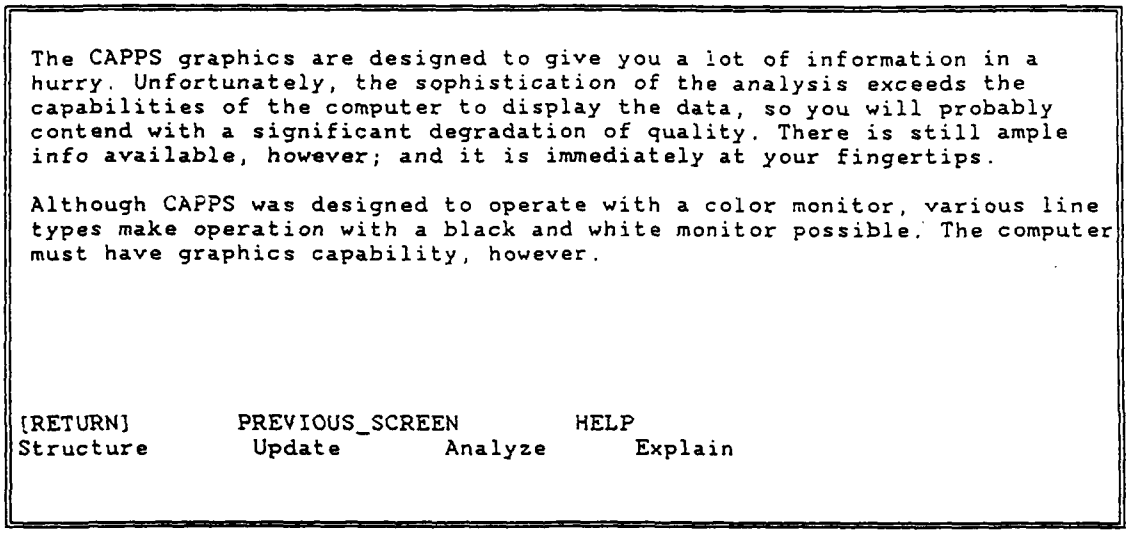


Fig. 14. CAPPS Menu Display Problem

One question in the opinion scale rated the participants' opinions as to the use of color for contrast. The mean participant rating for character contrast with the background was 4.71 with a standard deviation of 1.38. Figure 15 adds more summary statistics.

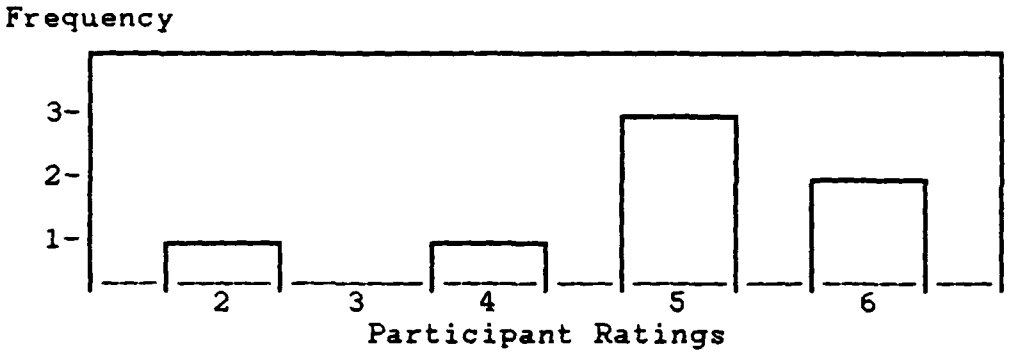


Fig. 15. CAPPS Contrast Histogram

The participants also rated how appropriate the overall use of color was. The mean participant rating was 5.42 with a standard deviation of .78. For the rating distribution and high and low ratings, see Figure 16.

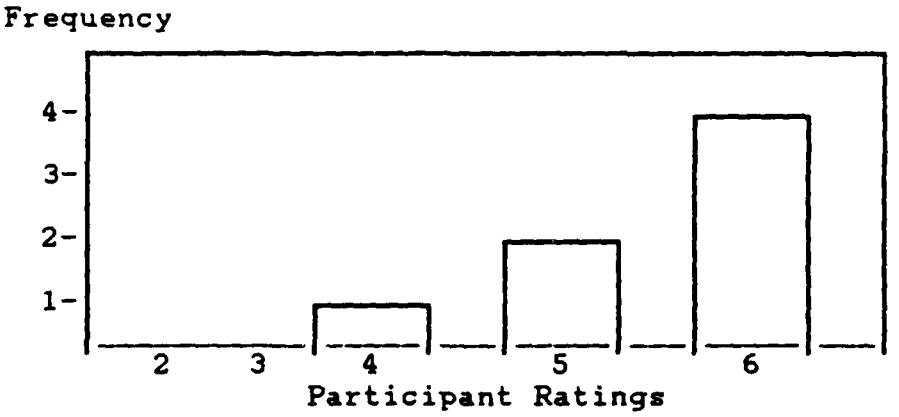


Fig. 16. CAPPS Overall Use of Color Histogram

Graphics. Three comments were made about the general usefulness of the graphical capabilities of CAPPS.

One participant expressed a dislike for the graphics stating the components shown were hard to distinguish from each other, so they would not be clear enough for overhead transparencies used at meetings. While the graphics resolution problem is just an opinion, the researcher did print out some graphics and found that without the color, the resolution between components was poor. It is important to note that two participants said the graphics were fine.

The participants rated the helpfulness of the graphics provided. The mean participant rating for the use of graphics was 5.14 with a standard deviation of 1.21. Figure 17 details the participant opinion rating range and distribution.

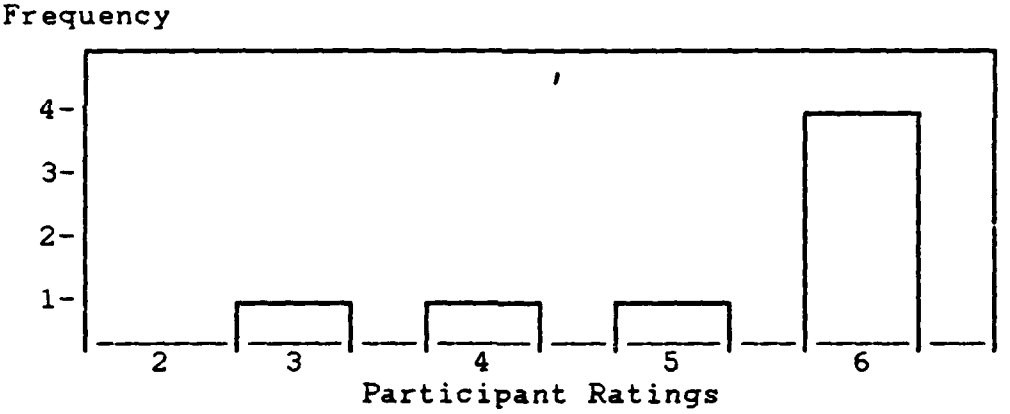


Fig. 17. CAPPS Graphics Histogram

Screen Layout. The neatness of the screen design was also rated by the participants. The mean participant rating on the overall screen display layout was 4.71 with a standard deviation of 1.38. For information on rating range and distribution, see Figure 18 below.

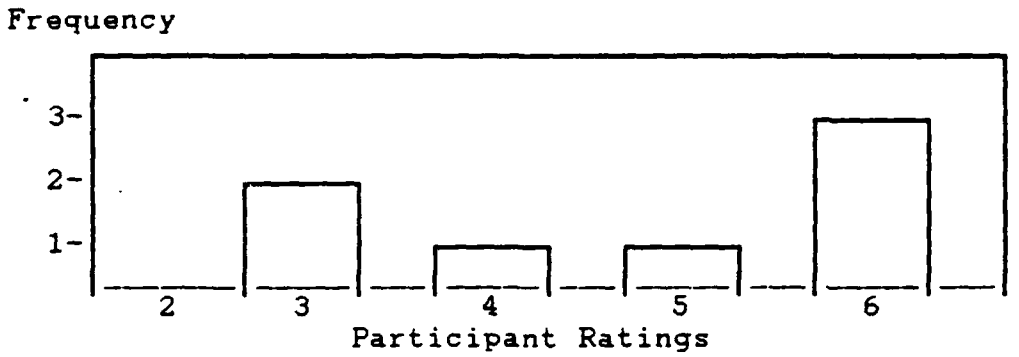


Fig. 18. CAPPS Screen Display Histogram

Documentation. Four opinions were expressed regarding documentation. One participant suggested a more detailed index in the documentation would be helpful. He also stated the documentation was "fine", but in reality busy program managers would not read it and would also prefer to have a pamphlet about three pages long to accompany the users' manual.

Two participants stated that some of the online help was weak. Both participants expressed the desire for more online instruction at points during the program. The points in particular involved the overview function, or the beginning screen and how to end a particular function without quitting the program.

The participants rated online help or documentation as to its usefulness. The mean participant rating for online help or documentation was 4 with a standard deviation of 1.82. Note three participants chose to answer this as not applicable since they did not use any online help. Figure 19 details range and distribution for online help ratings.

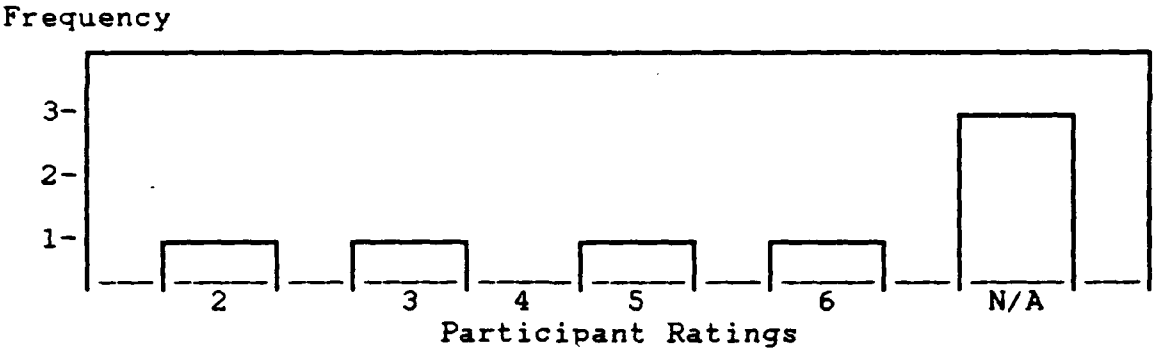


Fig. 19. Online Help Histogram

The participants also rated the layout of the written documentation as to its ease of use. They gave a mean rating of 4.42 for the general layout of the documentation. The standard deviation was 1.39. They also gave overall opinions about the helpfulness of the documentation. The participant mean rating was 4.57 with a standard deviation of 1.27. For detailed information regarding the ratings of the general layout and helpfulness of the written documentation, see Figures 20 and 21 below.

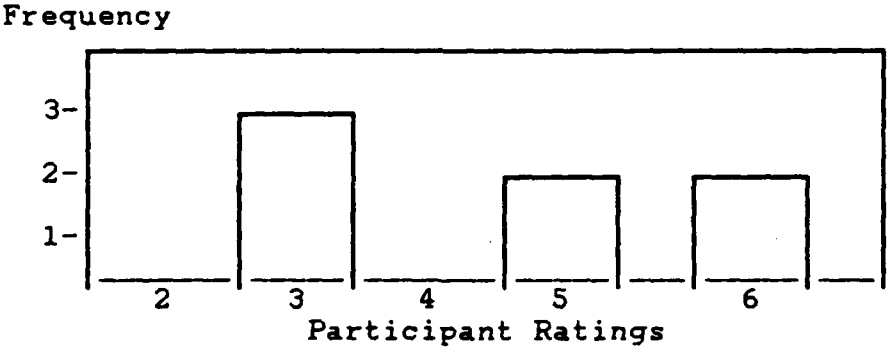


Fig. 20. CAPPS Written Documentation Layout Histogram

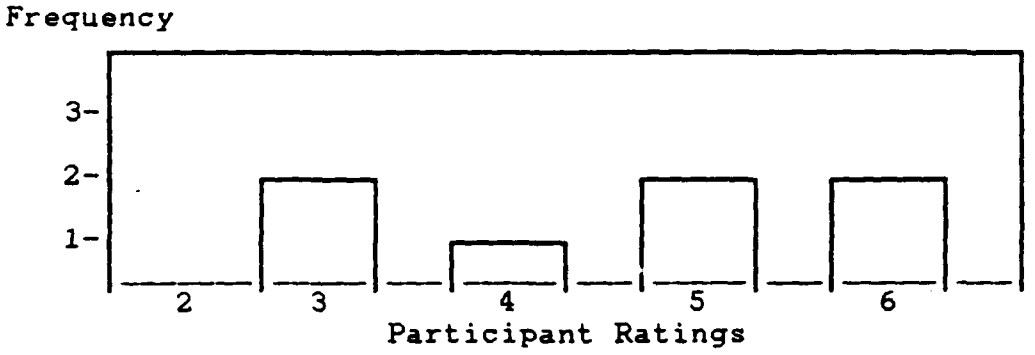


Fig. 21. CAPPS Overall Written Documentation Histogram

Response Time. The only opinions expressed about the system response time were those recorded on the written opinion scales. The participant mean rating for the response time was 5 with a standard deviation of 1.15. Figure 22 details participant response regarding system response time.

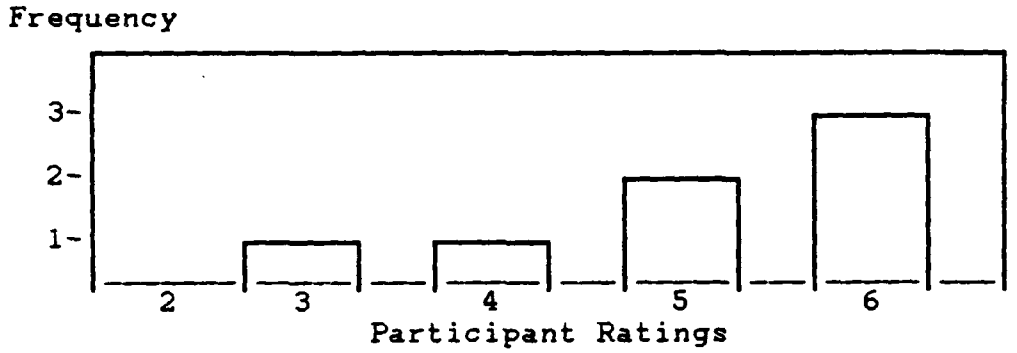


Fig. 22. CAPPS Response Time Histogram

Miscellaneous Comments. Two participants commented on the lack of a printing function in the CAPPS module as is provided in most other programs.

There was a problem that occurred with every CAPPS participant. It could be classified as a combination display/ feedback problem. In the database function after entering a new element name, the program displays the new name with a question to confirm the new name (see Figure 23). The program

displays the new name and the question without leaving a space between the two sentences. This made the participants think they had misspelled the new element name, when in fact they had not.

Three participants commented on ambiguity of terminology. Two participants, while trying to display a graph of trends, said the options "adjust", "expand", and "zoom" were confusing (see Figure 24). One participant said none of the options was intuitively obvious even after finding the correct one. Another participant said the definitions used by CAPPS in the database function (see Figure 25) needed to be more clear and distinguishable.

Update of Sample Data Base for May84 SHEET 143820

ELEMENT	NAME	BCWS	BCWP	ACWP	BAC	LRE
1.	LRP	143820	135992	141344	419600	419600
1.1	Air Vehicle	60000	56403	58230	132400	132400
1.1.1	Integ Ass'bly	1357	1382	1335	3762	3762
1.1.2	Airframe Segment	27122	22415	27788	55906	55906
1.1.2.1	Component Ass'bly	1806	1780	1785	14672	14672
1.1.2.2	Structure	25000	23500	26850	39234	41234
1.1.3	Engine	3800	3810	2846	6270	6270
1.1.4	Navigation/Guidance	24550	24375	22625	42636	42636
1.1.5	Payload Equipment	4406	4421	3636	5016	5016
1.2	Carrier Acrft Integ	10362	10192	10291	30700	30700
1.3	Mission Planning	6209	6275	6334	14100	14100
1.4	Training	5265	5188	5288	22850	22850
1.5	Peculiar Supp Equip	3799	3788	3752	19000	19000
1.6	System T & E	17052	15633	16942	56950	56950
1.7	System Management	31219	29907	31611	89950	89950
1.8	Data	4099	4095	4072	25400	25400
1.9	Site Activation	193	198	211	4800	4800
1.10	Common Supp Equip	2839	2827	2827	11925	11925
1.11	Idust. Facilities	1553	1486	1786	9525	9525
2.1	Logistics	8302	8213	8326	41575	41575

Adding 1.2.1 - Software Integrationno memo Sure? (Y/N)

Fig. 23. CAPPS Display/Feedback Problem

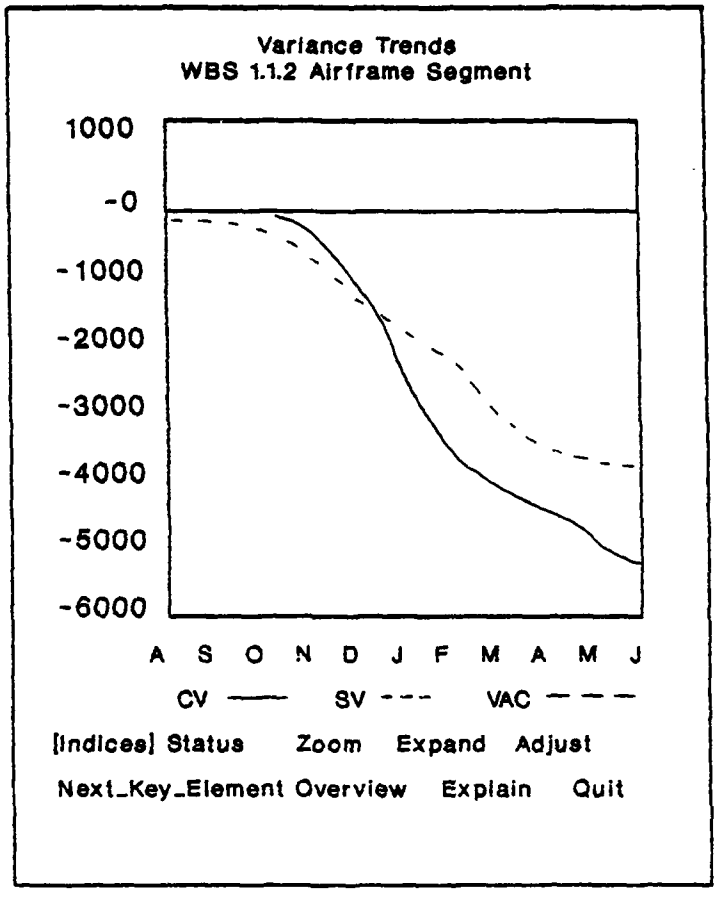


Fig. 24. CAPPS Terminology Problem

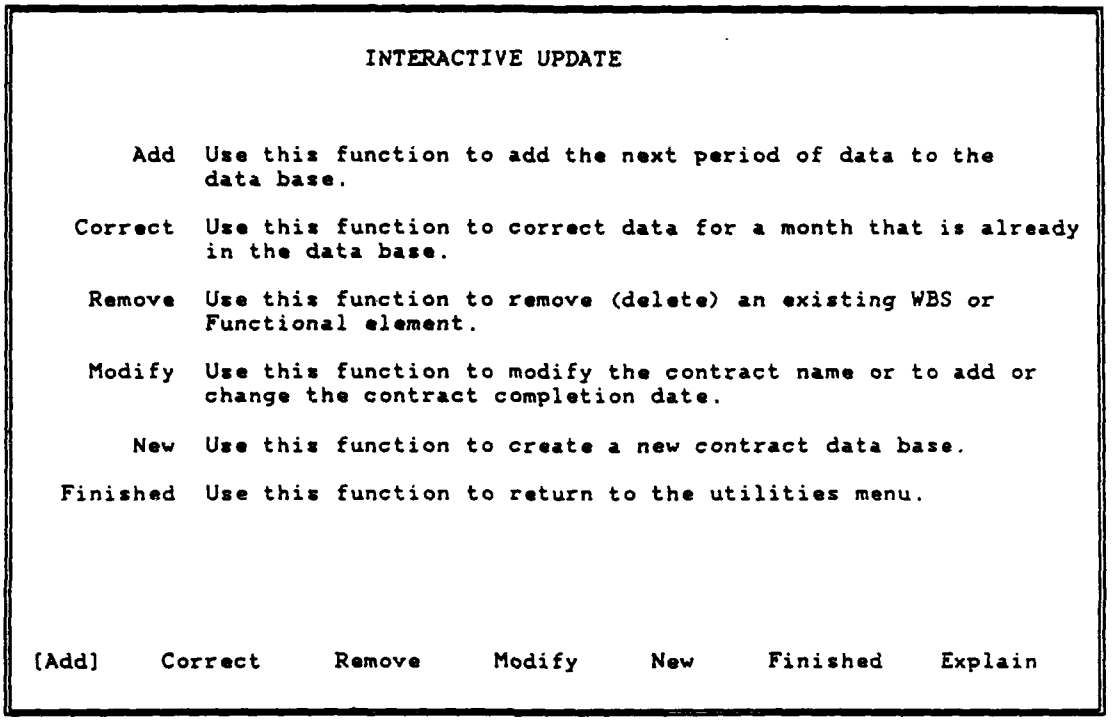


Fig. 25. CAPPS Database Definitions

V. Conclusions and Recommendations

Introduction

As in chapter four, H/C interface issues taken from the literature review will be used as a format for the body of this concluding chapter. Topics will be discussed in the same order as in chapter four. An overall evaluation of the PMSS H/C interface will conclude this chapter.

Each H/C interface issue discussed in chapter four will be reviewed and conclusions made regarding the PMSS effectiveness in those specific issues. Recommendations for improvements or further research will be made when warranted.

General Issues

Ease of Movement. Throughout the literature, authors have stressed consistency and have said it is a very important part of the H/C interface. This consistency not only includes issues within the program, but also issues common to most application programs. Many comments were made in both modules of the PMSS about the use of the space bar and backspace keys for movement. This is a weak area for the PMSS. The modules do not consistently use one method or the other and the participants were not comfortable with the PMSS approach. A large number of the participants in this study use spreadsheet programs in their day to day work and movement in spreadsheets usually involves arrow keys.

To make the PMSS consistent with other tools available for program managers and staff, the PMSS should be modified

to allow movement using the arrow keys throughout. Modifying the PMSS in this manner could help reduce user confusion and frustration.

Consistency in Sequences of Actions. Besides the movement issue discussed above, only one negative comment occurred. The PMSS needs to be consistent in the area of saving work just recently accomplished. The database functions save the work after the user exits, but in other areas, the work or changes are saved before the user exits. After taking care of the way users move about and how actions are closed out, this part of the interface could be considered adequate.

Offer Informative Feedback. Only a minor problem occurred in this area. The display time needs to be lengthened for at least one error message. This area of the PMSS H/C interface is adequate.

Design Dialogs to Yield Closure. There were a few minor problems in this area. Some participants had trouble realizing when a functional task was finished. There needs to be more system messages telling users when tasks are complete. A distinction also needs to be made whether or not the "Quit" option means quit the function or quit the program. For the most part, this area of the interface seemed adequate.

Error Handling

Correcting errors in the PMSS usually is not difficult, but it is not as easy as it should be. The PMSS should be modified so that all modules have online help. Installing the page back option, like the one in the GAT module, throughout the PMSS would make error correction easier. The system should also allow reversal of actions, such as changes to the database, to prevent catastrophic errors. Some programs provide a "Whoops" option that reverses an unwanted action that just occurred. This type of option would prevent some errors and might lead to a higher degree of user satisfaction. Without these changes, error handling in the PMSS is satisfactory, but as one participant stated, "a cumbersome process."

Display Issues

Color. In the issue of contrast, the PMSS uses color in an sufficient manner. The system uses default colors that did not trouble the participants greatly, but they did not feel the optimal choice or choices were used. The options available to the user are either limited or do not exist. First of all, the PMSS should be changed to allow color contrast options in all of the modules. Secondly, users should be allowed to choose from a variety of options or devise their own.

In general, color use in the PMSS is adequate. The PMSS does a good job of using color for highlighting or warning purposes. There is again the problem of color options. Again,

the system should be modified to allow color options in all modules, as is done in most application programs. All modules should also allow the user to turn off the colors. This would increase user satisfaction by allowing the user to modify the program to his/her own personal tastes.

Screen Layout. The layout of the PMSS was rated favorably by the participants and should be considered adequate. The screens are generally uncluttered and neat. Menu items are clearly distinguishable in the GAT module, but cramped in the CAPPS module. The menu item display needs to be made consistent with the choices clearly distinguishable. When editing text, the user should decide what is removed, instead of reaccomplishing the whole field. Modifying the PMSS in this manner would make the system consistent with other application programs available in the Air Force.

Graphics. The ability of the PMSS to display graphics is good. This conclusion is based on the CAPPS module only because the GAT module did not use graphics. More research needs to be done with PMSS graphics. This is an area the participants did not have to interpret during the scenarios. The participants just rated the general look and not the functionality of the graphics. The resolution of the graphics in some types of monitors and on paper may not be adequate.

Documentation

The written documentation provided with the PMSS is good. The approach of what to do, how to do it, and why do it, is effective for novice and intermittent users. The

documentation also uses screen representations in a way that is also helpful. The only modification this study recommends is the addition of a detailed index to aid users in searches.

The online documentation provided by the PMSS is somewhat less than adequate. The participants did not use the online documentation, but it was reviewed by the researcher and project officer. Messages or text displayed on the screen should be professional looking and should not try to be humorous (see Figure 26). The online documentation should be modified so all words are spelled correctly and attempts at humor reviewed carefully.

Response Time

This area of the PMSS H/C interface was rated very favorably by the participants and is comparable to most application programs. Some modules of the PMSS are more complex than others, but the response time should be no problem if the programs are on the microcomputer hard drive.

Conclusion

There is one major problem that is easily seen in the future for the PMSS, and that problem is consistency. The modules used in this and a parallel study, that will eventually be combined to form the PMSS, have significant differences in the many areas of the H/C interface. Some of the obvious differences include how color is used, the style of written documentation, the use and quality of graphics, the availability of online help, the way users move

throughout the programs, and even the basic interaction styles. The literature very strongly suggests that if consistency in the H/C interface is not maintained, users will not readily accept the PMSS.

Most of the issues of the H/C interface were handled adequately when these particular modules of the PMSS were developed. If the recommended modifications are accomplished, the system should be accepted very favorably in the user community.

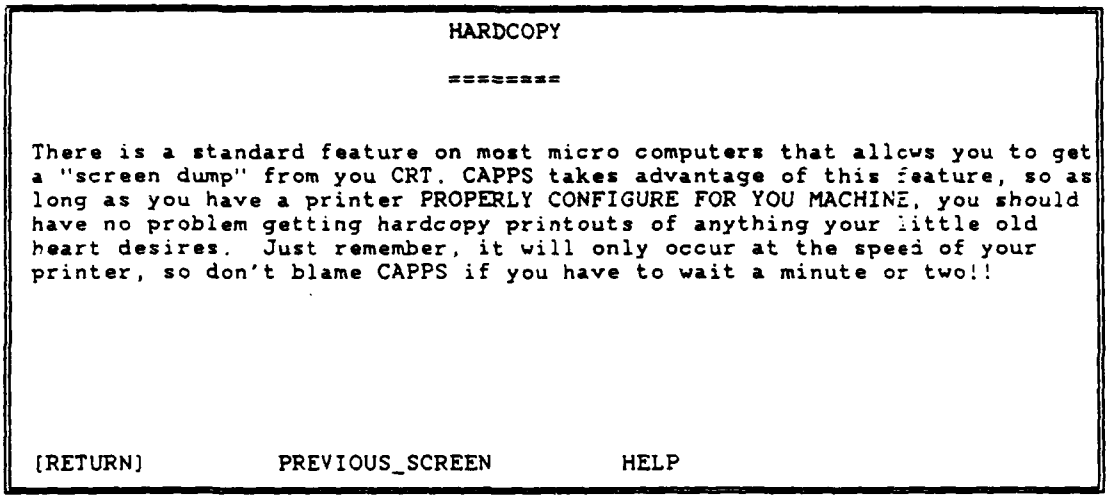


Fig. 26. CAPPS Message

Appendix A

GAT Scenario

GOVERNMENT ACTIVITY TASKING (GAT) SCENARIO

In this scenario, you will be using the GAT module of the Program Manager's Support System (PMSS). You will be asked to do tasks that might be found in your current job situation as well as those tasks that GAT was designed to accomplish.

Task #1 - Edit an existing activity. There has been a change in ECP 0011. Change the activity to reflect the following:

1. Appropriation = 2257
2. Required Completion Date = Jul 90
3. Milestone #2 should read "Transfer Funds to Sacramento ALC."
4. Tasking Organization Manager = Major Burns
5. Total FY Funding = 9.0
6. Labor = 4.0
7. 1st Quarter Indirect Support = .26
8. 4th Quarter Other Government = .35

Task #2 - Print the GAT Worksheet Summary for ECP 0006 (LRP Modification).

Task #3 - Create, Save, and Print a report with the following headers in the order they are listed below. Save the report under any name you desire.

1. Program Title
2. Required Completion Date
3. Fiscal Year
4. Labor
5. Funding Totals

Appendix B

CAPPS Scenario

CONTRACT APPRAISAL SYSTEM CAPPS SCENARIO

You are currently working in a system program office that is well into development of a new attack aircraft only known as the Long Range Penetrator (LRP). The program was started in August 1983 and is due to be completed in June 1986. The current month of development is July 1984 and the program office uses the Program Manager's Support System as a tool to track contract status.

Task #1

A. Print the status report of the element with the largest negative cost variance.

B. Print a graphical chart that shows the variance trends of the element with the largest negative cost variance.

C. Print a graphical chart that shows the current estimates at completion for that same element.

Task #2

A. Print the PMSS status report of element 1.6 (System T & E).

B. Print a graphical chart that shows the variance trends for element 1.6 over the past six months.

Task #3

A contractor makes an error reported in element 1.1.3 ACWP for March 1984. The value should read 3000. Change the data base to reflect the correct figure.

Task #4

A new element has been added to the LRP. It falls under element 1.2 Carrier Acrft. Integrity. Add the new element to the data base using the following information:

A. Element Name = 1.2.1 Software Integration
B. Start Date = June 1984
C. BCWS = 4000
D. BCWP = 4050
E. ACWP = 4500
F. BAC = 8000
G. LRE = 8000

Appendix C

PMSS Briefing Outline

General Overview for Intro to PMSS Briefing

-Introduction of individuals involved
  --Two AFIT students
  --Mr Miller ASD/XRI
  --Anyone else playing a part

-State the purpose of the briefing
  --Explanation of tasking (both ASD's and AFIT thesis)
  --Introduction to the PMSS
  --Introduction to our PMSS testing procedures
  --Setup of tentative interview calendar

-Explain the reasons for doing this research
  --ASD reasons
    ---Possible future use as a Decision Support System
      ----Inputs from research can change the prototype
      ----Inputs can influence the decision to use the PMSS
  --AFIT reasons
    ---Fulfill thesis requirements

-Introduction of the PMSS
  --Developer
  --Purpose of the system
  --Structure of the system
  --ID specific modules
    ---Explain the purpose of each

-Explain testing procedures
  --Stress the system is being tested and not the user
  --Stress anonymity of the interviewee
  --Explain protocol collection concept
  --Explain the use of recording devices
  --Explain documentation and scenario preview
  --Explain debrief at the end of interview

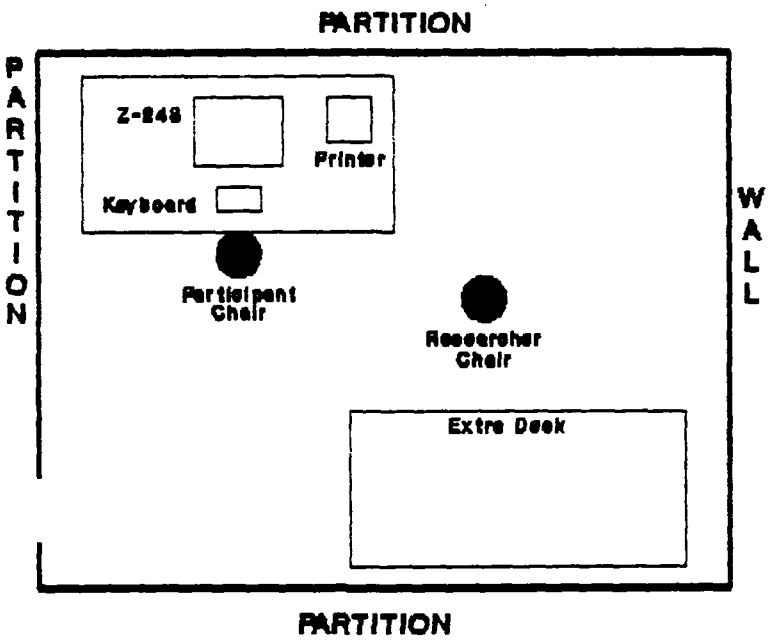
-Q & A

-Setup of tentative interview calendar

-Concluding remarks

Appendix D

Test Area Layout



Size = 12 feet by 12 feet

Appendix E

Agreement Statement

STATEMENT OF AGREEMENT

In order to collect your open responses and therefore the best possible data in this research effort, I want to again assure you of your anonymity. Any comments you give me while participating in this study will not be attributed to you in any way.

Kelly R. Fulcher, 1LT, USAF
PMSS Researcher

I understand my freedom to comment on any aspect of this research effort.

PMSS Research Participant

Appendix F

Game Details

The games used to warm up participants is called NYET. It was written by David B. Howorth in 1988 and is considered part of Public Domain software.

The game in its use and screen layout demonstrates many areas of the H/C interface. Graphics, color, text and numeral display, and etc. The object of the game is to fit falling shapes into a box, leaving as little blank space as possible. The speed is variable and points are accumulated by the number of falling shapes the user handles and by filling rows with shapes.

Appendix G

Opinion Scale

1. **Character contrast with background**

   poor/unreadable 0 1 2 3 4 5 6 excellent/readable

2. **Overall use of color**

   inappropriate 0 1 2 3 4 5 6 appropriate

3. **Online help facilities**

   not useful 0 1 2 3 4 5 6 N/A very useful

4. **System feedback or messages**

   confusing 0 1 2 3 4 5 6 clear

5. **Overall screen display layout**

   cluttered/messy 0 1 2 3 4 5 6 uncluttered/neat

6. **Overall use of graphics**

   not helpful 0 1 2 3 4 5 6 N/A helpful

7. **Ability to correct errors**

   hard/uses time 0 1 2 3 4 5 6 easy/time efficient

8. **Overall ease of movement throughout the module**

   hard/uses time 0 1 2 3 4 5 6 easy/time efficient

9. **Layout of written documentation**

   hard to use 0 1 2 3 4 5 6 easy to use

10. **Overall opinion of written documentation**

    not helpful 0 1 2 3 4 5 6 helpful

11. **Time it takes the system to respond to commands**

    too long 0 1 2 3 4 5 6 just right

Appendix H

Concluding Questions

1. Have you had any formal computer education?
2. Do you use a computer on the job?
3. Approximately how much time did you spend viewing the documentation?
4. Is this module something you could use on the job?
5. Do you have any concluding remarks?

Appendix I

GAT Summary Statistics

Question	Mean	SD	L. Value	S. Value	Obs.	Outliers
#1	5.142	.899	6	4	7	0
#2	5.428	.786	6	4	7	0
#3		Not Applicable to GAT				
#4	4.285	1.380	6	3	7	0
#5	5.285	.755	6	4	7	0
#6		Not Applicable to GAT				
#7	4.285	1.496	6	2	7	0
#8	4.571	1.902	6	2	7	0
#9	4.714	1.380	6	3	7	0
#10	5.142	.690	6	4	7	0
#11	5.428	.786	6	4	7	0

Appendix J

CAPPS Summary Statistics

Question	Mean	SD	L. Value	S. Value	Obs.	Outliers
#1	4.714	1.380	6	2	7	0
#2	5.428	.786	6	4	7	0
#3	4.000	1.825	6	2	4	0
#4	4.000	1.632	6	2	7	0
#5	4.714	1.380	6	3	7	0
#6	5.142	1.214	6	3	7	0
#7	4.285	1.603	6	2	7	0
#8	3.428	.975	5	2	7	0
#9	4.428	1.397	6	3	7	0
#10	4.571	1.272	6	3	7	0
#11	5.000	1.154	6	3	7	0

Appendix K

GAT transcriptions

Transcription GAT A

Task 1

Nar - The introductory screen is displayed.
Rschr - What do you think of the colors used?
Resp - This looks comfortable. (default colors)
Nar - The resp. edits the data as per scenario instruction.
Resp - One thing I would like to see on these things is when you have to scroll programs like this, going from left to right, it takes alot of time. I don't know why they don't set them up so you can scroll down one side and go over if you need to. That would be more efficient.
Nar - The resp. finishes the task.
Resp - Well, I've done everything required for task 1 and as I said, the only thing I would change is the way you scroll around the page.

Task 2

Nar - The GAT worksheet summary page is displayed, which is where the last task ended. The resp. completes the task without further comment.

Task 3

Nar - The GAT worksheet summary page is displayed, which is where the last task ended. The resp. begins to create the report as per scenario instruction. The resp. made an error of creating a new ECP and then proceeded on the right path to create the report.
Resp - It would be nice if these (headers) were in alphabetical order. They would be alot easier to find.
Nar - The resp. is about halfway through the task.
Resp - Is this going to print the complete title?
Rschr - Yes.
Resp - It is not going to drop the title and end off.
Rschr - No, it prints it all even if it cuts it off on the screen.
Nar - The resp. finishes the task.
Resp - Say you're modifying something and your eyes get tired, all you have to do is go back to the main screen with the F10 key and you can change colors.

Rschr - Yes.
Resp - Some of our programs can't change and that drives you crazy after awhile.

Scale

. No Expanding Comments

Concluding Remarks

Q #1 - I took some college courses in programming Fortran.
Q #2 - Yes, all of the project officers use the computer alot. It is mostly used for word processing and making charts.
Q #3 - About a half and hour.
Q #4 - We don't do this, our finance office does it.
Q #5 - Sometimes I question the use of fancy software. I do prefer a dark blue background with cyan, white, or pinkish lettering.

Transcription GAT B

Task 1

Nar - The introductory screen is displayed. The resp. edits per scenario instruction.
Resp - You just enter to move on down. I guess the arrow keys can be used also, but they don't let you edit that way.
Rschr - Do you think they should use the arrow keys for editing.
Resp - I guess you can look at it either way. On the first screen it didn't allow you to move with the arrow keys and on the second it does. They need to make it consistent one way or the other. I figured you could move in the text with the arrow key because the first screen wouldn't allow it. Some programs allow you to move between blocks with the tab key and then let you use the arrow key within for editing.
Nar - The resp. nears finishing the task.
Resp - The editing ought to start over on the forward right edge like a calculator and force the number out as it goes. That way you would know you are typing over it.

Task 2

Nar - The summary screen is displayed and that happens to be where the last task ended. The resp. completes the task without further comment.

Task 3

Nar - The summary screen is displayed, which is where the last task ended. The resp. proceeds to create the report as per scenario instruction.
Resp - I'm not sure how they determined the order of those (headers), but I think it would be better if they were alphabetized or in at least some kind of order.
Nar - The resp. finishes the task without further comment.

Scale

Q #1 - Character contrast was OK, but I usually like the dark blue background with the light blue writing. It is not quite as stark a contrast as white and is more readable than grey.
Q #2 - I like the dark blue background the best of all the choices. Overall use of color is fine. I don't see any problem with it.
Q #4 - Most of the queries are pretty self explanatory except where it asked you if you want to save the changes. The way I've seen other programs do it is... they will ask if you really want to quit and then ask you if you want to save the changes.
Q #7 - Ability to correct errors leaves something to be desired. When you start typing, blank it and then put on the new numbers or have a little window and when you fill it, it automatically changes it.
Q #8 - The module is pretty easy to move through.
Q #9 - The written documentation was pretty decent, it just seemed to be alot longer than it needed to be, considering how simple this thing is to use. I don't know, it may be necessary.
Q#10 - It was OK. It certainly wasn't bad, because after I read it I felt pretty confident that I could go in and after a little playing around, I could use the thing.

Concluding Remarks

Q #1 - I've had basic Fortran, microprocessor programming, and machine language programming.
Q #2 - Every day and all the time. I use it for word processing, spreadsheets, schedule tracking, desktop publishing, and briefing slides.
Q #3 - About one half an hour.
Q #4 - Relevant in some cases.
Q #5 - Like most government developed software, the function seems to be more important than the user interface. It is not as user friendly as most but not all commercial software. This one is simple enough that it doesn't make mush difference.

Transcription GAT C

Task 1

Nar - The introductory screen is displayed. The resp. begins to work the task.
Resp - Does this thing go up (cursor)?
Rschr - What did you hit?
Resp - The up arrow key.
Nar - The resp. figures the problem out using other keys and continues.
Resp - It won't take that 75 out of there.
Rschr - Hit return.
Resp - Oh...
Rschr - Is that different from what your used to.
Resp - The space bar would normally take that out and I would continue on typing.
Nar - The resp. continues and finishes the task.

Task 2

Nar - The summary page is displayed, which is where the last task ended. The resp. tries the color switch and leaves it on the default. The resp. then finishes the task.

Task 3

Nar - The summary screen is displayed, which is where the last task ended. The resp. works the task as per scenario instruction.
Resp - Oh...
Rschr - What did you do?
Resp - I hit F4 to try and load it (header) into the box.
Nar - The response was incorrect and then the resp. tries to type the header into the box, again without success. The resp. Then hits return, and receives a message stating it was an invalid response. The resp. then tries to edit and insert the headers, which is again incorrect. The resp. then looks in the documentation and finds the correct header entry method. The resp. then finishes the task.

Scale

Q #1 - That was OK.
Q #3 - They were clear.

Concluding Remarks

Q #1 - Intro to computers for BA degree and OJT for DBase.
Q #2 - Not much, just word processing mostly.
Q #3 - 5 minutes.
Q #4 - This is relevant to my job.

Transcription GAT D

Task 1

Nar - The introductory screen is displayed and the resp. begins to work the scenario.
Resp - Lets see... How do you move around? Oh... Only the right and left arrow keys work.
Rschr - Do you have a problem with that?
Resp - No I don't, it is just different from what I'm used to doing. Does it have a home key to take it to the top?
Nar - The resp. tries the backspace key and meets success.
Resp - Oh... OK, I don't have a problem with that. I would have to use it a couple of times as an adjustment to get away from the arrow key.
Nar - The resp. continues to work the task.
Resp - Does it file in Caps.? I've got some programs that it doesn't matter how you type it, it stores it in Caps. I did it that way because I'm used to that.
Nar - The resp. finishes the task.

Task 2

Nar - The summary screen is displayed, which is where the last task ended. The resp. finishes the task without comment.

Task 3

Nar - The summary screen is displayed, which is where the last task ended. The resp. begins the task as per scenario instruction.
Resp - I like the option where you just run the cursor over it (header) and highlight it, and then hit the enter key and drop it down. I think that is a good feature. In this I also like the option of using all the arrow keys to go left, right, up, or down.
Nar - The resp. then finishes the task.

Scale

Q #1 - I did like the character contrast with the background and I did like the options available to change that.
Q #2 - The was great, although if you had a system that didn't have color, I don't think it would be a negative.
Q #7 - That would be very easy.
Q #8 - Very good.
Q #9 - I like that users manual. I like the step through sequence.
Q#11 - Since this is with a disk and not a hard drive, I think the system response is excellent.

Concluding Remarks

Q #1 - I've had some basic OJT courses.
Q #2 - I use the computer every day for monitoring and creating schedules. I also use them for briefing slides.
Q #3 - 10 minutes.
Q #4 - The module is 50% relevant to my job.

Transcription GAT E

Task 1

Nar - The introductory screen is displayed. The resp. tries the color toggle switch.
Resp - I like this best (default option).
Nar - The resp. is working on editing as per scenario instruction.
Rschr - Why did you hit the space bar?
Resp - I hit the space bar so the cursor would go over.
Rschr - What did it do?
Resp - It just stayed there. It printed out the two in white letters instead of the grey letters.
Rschr - So you were expecting the grey letters?
Resp - I was expecting it to cover the grey letters. Say right here on 1.5, I tried to put 2 and press the space bar, and it wouldn't go over it.
Rschr - What do you think about that?
Resp - I've used programs before that you could hit the space bar and so in the block your using if you hit the space bar, it goes over two spaces like I wanted it to. Now I have to go back and change it.
Nar - The resp. continues with the task.

Rschr - Are you wondering why that 90 stayed there?
Resp - Yes, but then i realized if your going to change the block, you have to change the whole block. It takes a little bit of experimenting to realize that.
Rschr - Would you prefer they left you the option of changing what you want to change and leaving the rest?
Resp - It might make it a little easier. I would prefer it.
Nar - The resp. changes a milestone title.
Resp - I'd like to keep some of the stuff in there if I could, but when I go it will erase everything.

Task 2

Nar - The summary screen is displayed. The resp. completes the task without further comment.

Task 3

Nar - The summary screen is displayed. The resp has some difficulty accomplishing this task, but the only comments made during that effort are as follows.
Resp - Why can't you just type them (headers) out?

Scale

Q #1 - They only give you three color choices. I know the Z-248 has 16 different color bands.
Q #4 - System feedback was good.
Q #5 - The overall screen display was neat, very orderly, and a good job.
Q #7 - You had to realize where you were at to correct errors.
Q#10 - I thought the documentation was fairly easy to use. This is much easier than the usual Z-248 documentation.
Q#11 - Perfect, right away.

Concluding Remarks

Q #1 - One computer science course. It was an all encompassing introduction to computer science course.
Q #2 - Yes, mostly for word processing.
Q #3 - Just for a few minutes.
Q #4 - Yes, we do ECP work.

Transcription GAT F

Task 1

Nar - The introductory screen is displayed. The resp. edits as per scenario instruction. The resp. tries to use the up and down arrow keys to move and can't.
Rschr - Would you prefer being able to use the up and down arrow keys also?
Resp - Yes.
Nar - The resp. continues on the editing process.
Resp - How do you move the edit cursor to the right?
Rschr - You have to type over it.
Resp - Well... I don't like that.
Nar - The resp. is trying to edit the funding numbers.
Rschr - Is it strange having the previous numbers stay there?
Resp - Yes, it is a little confusing. I guess it is OK after the first time you go through it. For somebody that is not an experienced user, it could be a little confusing.

Task 2

Nar - The summary screen is displayed. The resp. takes this time to try the color toggle switch before finishing the task.
Resp - I would not choose any other color than the default option. I like a dark blue background with light blue lettering the best.

Task 3

Nar - The summary screen is displayed. The resp. has no problems with entering headers and begins to finish the task.
Resp - It says the field size and length is so and this header is much longer than that.
Rschr - It prints it all, but it cuts it off on the screen.
Resp - It will truncate it?
Rschr - Any problem with that?
Resp - Mmm... I guess with other databases it is fairly normal, so probably after you have been through it one time, you'll be OK. Are these (headers) on the screen in any particular order?
Rschr - I don't think so.
Resp - It would help in finding them if they were in alphabetical order.
Nar - The resp. finishes the task and tries to save the report format, but fails to do so.
Rschr - What did you hit?
Resp - F10 to exit.

Rschr - There was a save option. Maybe it didn't show up very well.
Resp - Obviously I missed it, but I think I was programmed from the previous task to exit before I could save.

Scale

No Expanding Comments

Concluding Remarks

Q #1 - I've done a little basic. I'm not an expert, I have just played around with microcomputers at home.
Q #2 - Word processing, spreadsheets, and viewgraphs.
Q #3 - 35-40 minutes.
Q #4 - I would probably use it if I had to manage several projects in a program.
Q #5 - I don't see much wrong with it. It is pretty good really... Just a couple of minor problems.

Transcription GAT G

Task 1

Nar - The introductory screen is displayed. The resp. begins to perform the task.
Resp - Is "return" the only way you can reverse your fields?
Rschr - Try it. (resp. does) Does that bother you?
Resp - You just can't go back.
Rschr - It is not as direct as an up or down key.
Resp - I just didn't realize.
Nar - The resp. continues the task and now needs to change some numbers in the scenario ECP.
Resp - Are these fields formatted for decimal places?
Rschr - I'm sure they are formatted someway.
Nar - The resp. comes to the point where the scenario asks the resp. to change a milestone name. The resp. attempts to delete a part and encounters a problem.
Rschr - What did you try to do?
Resp - I tried to delete a word.
Rschr - With the delete key?
Resp - Yes.
Rschr - What do you think about that?
Resp - I should be able to go in and move characters around instead of typing over everything. You can't space with the cursor either, it just jumps to the next field.

Task 2

Nar - The summary screen is displayed. The resp. works the task without problem or comment.

Task 3

Nar - The summary screen is displayed. The resp. works at making the report as per scenario instruction. The resp. had considerable trouble getting the headers to appear in the lower box.
Rschr - What key did you hit to get that?
Resp - F4.
Rschr - What did you try after F4?
Resp - I just tried typing the header name in.
Nar - The resp. finishes the task without further comment.

Scale

Q #8 - Normally, packages use a tab key to shift from box to box. It seemed like you had to go a long way. It seems like you could use a shift or back tab.

Concluding Remarks

Q #1 - Alot of classes on a couple of programming languages. Nothing done on a PC.
Q #2 - Yes, for charts, graphics, and networking, and E-mail.
Q #3 - About an hour.
Q #4 - It has possibilities. It would have some benefits for what I do.

Appendix L

CAPPS Transcriptions

Transcription CAPPS A

Task 1A

Nar - The resp. is viewing the overview screen at the beginning of the program. The resp. chooses the "all elements" option. The resp. moves to the element in question and presses return.
Resp - This is what I print. What does the highlighting mean?
Rschr - It is a warning that something isn't right with this element.

Task 1B

Nar - The resp. is at the point where the status report is showing for the element in question. The resp. chooses the "overview" option from the menu. This choice puts the resp. back to where he was before.
Resp - I thought that overview was going to tell me something more about this element... or explain would do that too.
Rschr - It always takes you back to the beginning screen.
Nar - The resp. then tries the "cumulative performance" option, which is on the correct path.
Resp - The graphics is hard to distinguish.
Rschr - You don't think that is very clear?
Resp - No, not at all. It doesn't jump out and grab me... it is hard to distinguish. You should have a different scale on this that is more separable. If you were going to use these graphics, it would never work. You couldn't tell the difference between these lines if they were projected on a screen.
Rschr - Now you need to find the variance trends, because you are still on cumulative performance.
Resp - Oh... I'm used to a cursor showing me where I'm at.
Nar - The resp. then finishes the task by locating the variance trends on the next keystroke.

Task 1C

Nar - The resp. is at the point where the last task left off. The variance trends screen is displayed. The resp. then chooses the "indices" option that leads to his correct choice of the "EAC" option. The EAC screen is displayed.

Resp - The lettering ought to be from left to right (the screen shows the EAC lettering as up and down).
Rschr - Anything else you want to say about this?
Resp - Just the same point about the graphics.

Task 2A

Nar - The resp. is at the point where the last task ended. The EAC screen is displayed. The resp. gets off track for a couple of minutes and finds the correct element to begin the task. The resp. the chooses the "status" option and accomplishes the task.

Task 2B

Nar - The resp. is at the status screen, which is where the last task ended. The resp. chooses the correct option and gets to the variance trends screen.
Resp - Zoom or adjust? (chooses adjust, which is not correct) It is not status or explain.
Nar - The resp. chooses the "key element" option and it exits out of the element being worked on.
Resp - Start that one over again huh...
Nar - The resp. gets back to the correct element by spacing across the key element screen to the element in question. The resp. then chooses the "zoom" option and ends the task.
Resp - When I saw zoom, I thought that it would zoom in on one particular piece instead of changing the scale. The zoom and adjust options are confusing.

Task 3

Nar - The resp. is at the variance trends screen, which is where the last task ended. The resp. chooses the "utilities" option and is faced with the utilities explanation screen and menu options.
The resp. chooses the "interactive update" option, which is the correct choice. The resp. then faces the interactive update explanation screen and menu options. The resp. then chooses the "correct" option, which is correct for the task.
Resp - This is something like Lotus 123.
Nar - The resp. finishes the task.

Task 4

Nar - The resp. is at the spreadsheet screen, which is where the last task ended. The resp. chooses the

"add element" option from the menu and fills in the data the program asks for.

Resp - Did I misspell that?

Rschr - No, that is a bug in the program. Go ahead and answer yes.

Resp - Did my 1.2.1 get put in? No it isn't in there.

Rschr - You might want to go back to the utilities screen again. We didn't really get out of the other task.

Nar - The resp. chooses the "finished option" and the utilities menu is displayed. The resp. chooses the "interactive" option which is correct. The resp. then chooses the "correct" option after some confusion.

Resp - I guess we should try the Mar84 time frame and see what happens.

Rschr - There you go, it has your new element in there now.

Nar - The resp. then fills in the data and finishes the task.

Scale

No Oral Comments

Closing Remarks

Q #1 - Air Force familiarization courses in AMS, Wang, and Zenith familiarization.

Q #2 - Word processing & viewgraphs.

Q #3 - Probably not relevant to job.

Q #4 - 10 minutes.

Q #5 - The program would be more relevant to program managers.

Transcription CAPPS B

Task 1A

Nar - The resp. starts at the overview screen.

Resp - The bracketed one should be the next chosen.

Nar - The resp. chooses the correct sequence and arrives at the status screen as per scenario directions.

Resp - I like the highlighting.

Task 1B

Nar - The resp. is at the status report screen, which is where the last task ended. The resp. presses the "cumulative performance option, followed by the "variance trends" option and finishes the task.

Task 1C

Nar - The resp. is at the variance trends screen, which is where the last task ended.
Resp - I don't even see EAC.
Nar - The resp. chooses the "indices" option and then sees the EAC option. He then chooses that option and finishes the task.

Task 2A

Nar - The resp. is at the point where the last task ended. The EAC screen is displayed.
Resp - If I use "quit", do I go all the way back to the beginning?
Nar - The resp. chooses the "next key element" option. He then tries a couple of other options before arriving at the correct point. He then finishes the task.

Task 2B

Nar - The resp. is at the point where the last task ended. The screen shows the status report of the element in question.
Resp - I believe zoom is the last six months.
Nar - The resp. chooses the cumulative performance, variance trends, and zoom options to complete the task.

Task 3

Nar - The resp. is at the point where the last task ended. The variance trends screen is displayed. The resp. chooses the "overview" option and then the "select element" option, the latter being incorrect. The resp. then uses the "overview" and "utilities" option to arrive at the explanation screen for the utilities.
Resp - It says to correct, so there is correct... I think I'll use "correct."
Nar - The resp. corrects what the scenario calls for and completes the task.

Task 4

Nar - The resp. is at the point where the last task left off. The spreadsheet screen is displayed. The resp. uses the finished option and that takes him back to the utilities explanation screen.

Resp - I find this one a little confusing. I've got an option to remove part of a WBS... I assume there should be one to add a part, besides just the next period of data.
Nar - The resp. uses the "correct" option and begins to add the new element. The bug in the program shows up.
Resp - I don't think I typed that.
Rschr - I think that is a bug in the program.
Nar - The resp. proceeds and finishes the task.
Resp - Well, that is a neat program.

Scale

No expanding comments

Closing Remarks

Q #1 - Computer Education class and Fortran a long time ago.
Q #2 - Doesn't use a computer very often. I don't have one.
Q #3 - 15-20 minutes
Q #4 - Useful, but not for me right now.
Q #5 - No more comments.

Translation CAPPS C

Task 1A

Nar - The overview screen is displayed. The resp. uses the "all element" option and chooses the desired element.
Resp - I guess I would print this to answer the first question.
Rschr - Right.

Task 1B

Nar - The status screen is displayed, which is where the last task ended. The resp. then chooses the "cumulative performance" option and ends the task by choosing the "variance trends" option.

Task 1C

Nar - The variance trends screen is displayed, which is where the last task ended. The resp. goes off track awhile by choosing the "status" and "overview"

options. The resp. backtracks through the "cumulative performance", "variance trends", and "Indices" options to end the task.

Task 2A

Nar - The EAC screen is displayed, which is where the last task ended. The resp. finds the way to element 1.6.
Resp - This is the chart to print.
Rschr - OK.
Nar - The resp. ends the task by printing the status report.

Task 2B

Nar - The status report screen is displayed, which is where the last task ended. The resp. chooses the appropriate options and finishes the task.

Task 3

Nar - The variance trends screen is displayed, which is where the last task ended. The resp. has a hard time realizing he needs to view the overview screen to start the task. The resp. tries using the element options before going to the overview screen and choosing the "utilities option. The utilities explanation screen is displayed and the resp. chooses the "interactive" option.
Resp - I want to correct this.
Nar - The resp chooses the "correct" option. The resp. tries to move to the area on the spreadsheet.
Resp - I can't move so the highlight box shows the numbers I want.
Nar - The resp. then uses the arrow keys and accomplishes the task.

Task 4

Nar - The spreadsheet screen is displayed, which is where the last task ended. The resp. chooses the "finish" option and goes back to the utilities explanation screen. The resp. reads the screen in search for the appropriate option and chooses the "modify option, which is not appropriate. The resp. then chooses the "correct" option and proceeds to enter the data as called for.
Rschr - Is your element in there yet?
Resp - 1.1.2... No.
Nar - The resp. then tries to find the new element by

going back. The resp. finds the new element, but in doing so, he somehow erased the numbers in the database. This was not realized until later in the interview. The resp. finishes the task by adding the data that is called for.

Resp - I was using the hit or miss method and I should have been using the manual.

Rschr - That is one way to do it, but the hit or miss is another.

Scale

Q #7 - The ability to correct errors I had a problem with. Again... I don't know how much at fault this is... it may be my inabilities.

Concluding Remarks

Q #1 - System Command introduction to Graftalk and Wordstar.
Q #2 - I'll be using it some.
Q #3 - I think it is highly relevant for program management.
Q #4 - About 15 minutes.
Q #5 - I think the first time user will be confused somewhat in how to get around. I have a problem with the program. It is too easy to destroy the database. If you make a change, it should keep the old and ask if it should delete it.

Transcription CAPPS D

Task 1A

Nar - The overview screen is displayed for the start. The resp. chooses the "all elements" option and finds the one the scenario calls for. The resp. then finishes the task.

Task 1B

Nar - The status report screen is displayed, which is where the last task ended.

Resp - Whoops... I don't want that.

Rschr - You just hit the arrow key?

Resp - Yes.

Rschr - What do think about the way they move around. I can see your probably used to using a spreadsheet.

Resp - Yah, your right. I'm just used to using arrow keys. The spacebar is alright, it is just not what I'm used to.

Nar - The resp. had lost the element that was needed, so he went back to the desired element. The resp. uses the arrow keys again to try and move in the menu.

Rschr - I can see your used to arrow keys.

Nar - The resp. chooses the "cumulative performance" option and then the "variance trends" option to finish the task.

Task 1C

Nar - The variance trends screen is displayed, which is where the last task ended. The resp. gets off track by going back to the status screen for the whole program.

Rschr - Your in element one which is the whole program. You need to get back to the element you were in.

Nar - The resp. then finds the way back to the desired element. The resp. then chooses the correct path to the EAC screen to finish the task.

Task 2A

Nar - The EAC screen is displayed, which is where the last task ended. The resp. chooses the "quit" option in an effort to get to a screen with options for a change in element selection.

Resp - Thanks for using CAPPS...laughs.

Rschr - Did you think it was going to quit that one option and put you back on the main screen again?

Resp - Well... I was lost and didn't see what I wanted or I didn't recognize how to get back to your option screen. I would have preferred some instructions there.

Nar - The resp. then loaded the program again and found the desired element and finished the task.

Task 2B

Nar - The status report screen, which is where the last task ended is displayed. The resp. then works to the variance trends through the "cumulative performance" option.

Rschr - Does that confuse you or does the menu showing the "variance trends" option grab your attention more than the title?

Resp - Well... I was focusing down there. They could throw a color combination up there that could reinforce where your at.

Nar - The resp. then chooses the "zoom" option to finish the task.

Task 3

Nar - The variance trends screen is displayed, which is where the last task ended. The resp. then chooses the "utilities" option and views the explanation screen. The resp. chooses the "interactive" and "correct" options and finishes the task.

Task 4

Nar - The spreadsheet screen, which is where the last task ended, is displayed. The resp. chooses the "add element" option and adds the information that is asked for. The bug in the program is explained and the resp. continues.

Rschr - It looks like you misspelled it doesn't it.

Resp - Yes.

Rschr - You didn't. I think it is a bug in the system. Did it put the new element in for you?

Resp - No, it's not there.

Nar - The resp. goes back to the explanation screen and then the new element appears.

Rschr - What do think about that? That could be confusing. What do you think should happen?

Resp - If you can't follow this completely through on the one screen when you build on your database, it should tell you on that or the next screen.

Scale

Q #6 - I had no problem with it.

Q #9 - It's probably alright compared to others.

Concluding Remarks

Q #1 - Air Force introduction to microcomputer applications. I had a college course in computer theory and simple programming.

Q #2 - I use Lotus alot almost exclusively.

Q #3 - It is not that relevant to me, but I can see it for others.

Q #4 - 1 hour.

Q #5 - No comment.

Transcription CAPPS E

Task 1A

Nar - The resp. is viewing the overview screen. The resp. then chooses the "all element" option.
Resp - I don't care for these (spacebar and backspace keys), I'm used to using the arrow keys to go back and forth.
Nar - The resp. finds the appropriate element and displays the status report, thereby finishing the task.
Resp - That wasn't too bad to find in here.

Task 1B

Nar - The resp. is at the point where the last task ended. The status report screen is displayed. The resp. tries the "explain" option. The resp. then tries to use the "previous screen" option.
Resp - Can't go back any further. That's bad, I had to press this three times just to be able to read it. I guessed at it.
Rschr - Too quick a system message?
Resp - Yes... Way too quick. It should stay on there until you hit whatever.
Nar - The resp. then tries the "cumulative performance" option, which is the correct path. The menu shows the option "variance trends" among others.
Resp - It's that... right?
Rschr - No, your on cumulative performance.
Resp - Oh, OK variance trends... OK.
Rschr - Do you have a hard time seeing the title on the top verses the menu?
Resp - I think I tend to focus more on this (the menu).
Nar - The resp. chooses the "variance trends" option, and finishes the task.
Resp - Why don't they just put print or output in the menu?
Rschr - There is no print programming in the program. It just uses what is available with the computer.
Resp - Most systems that I've used will take you to a file system with options and then it prints it right out.
Rschr - Do you think there should be a print function?
Resp - I would put one in.

Task 1C

Nar - The resp. is at the point where the last task ended. The variance trends screen is displayed. The resp. then decides to proceed with the

"indices" option. This shows the desired "EAC" option and the resp. finishes the task.

Task 2A

Nar - The screen displayed is the EAC screen, which is where the last task ended. The resp. chooses the "overview" option and the "all elements" option to reach the status report of the desired element and finish the task.

Task 2B

Nar - The screen displayed is the status report screen, which is where the last task ended. The resp. chooses "cumulative performance", "variance trends", and "zoom" options and finishes the task.

Task 3

Nar - The resp. chooses the "overview" option and leaves the variance trends screen that ended the last task. The resp. chooses the "utilities" option and the "interactive update" option to enter the database. The resp. chooses the "correct" option and enters the spreadsheet and corrects the mistake as per scenario directions.

Task 4

Nar - The screen displayed is the spreadsheet screen, which is where the last task ended. The resp. moves to the database option explanation screen. The resp. then chooses the "correct" option and the spreadsheet is displayed.
Resp - This is where I want to be to add a new element to the LRP?
Rschr - Go ahead and try out what you've got there and see if you can add a new element.
Nar - The resp. presses the slash key to display the menu.
Resp - There is "add element".
Nar - The resp. chooses the "add element" option and adds the required information the program calls for. The resp. passes over the bug in the program without noticing it and finishes the task by entering the correct data.
Resp - Spreadsheets are the best thing going. I use them all the time. Is this... I need to ask. Blue and

yellow is what I always use. Can you change the colors in CAPPS.

Rschr - I think this is about it for this program.

Resp - The color isn't controlled by the operating system.

Rschr - It is controlled by the software.

Resp - I'd rather have blue and yellow. White drives my crazy. The blue is alright but white bothers my eyes after awhile.

Scale

No Expanding comments.

Concluding Remarks

Q #1 - Three courses in graduate school. They were in basic programming and information systems.

Q #2 - Yes, at least 50% of the time.

Q #3 - It is pretty good. I work with someone that uses it all the time. It is relevant.

Q #4 - About 5 minutes

Transcription CAPPS F

Task 1A

Nar - The resp. is looking at the overview screen before starting the task. The following is in regard to the menu.

Resp - One thing, I think what works... I guess it takes just getting used to it, but I like when it highlites with a different color. You can see this, but to me it would be alot quicker and more contrasting if just a different color.

Resp - Do these arrow keys work.

Rschr - Go ahead and try it.

Resp - No. So you just have to page through them if you want to get back to where you were.

Rschr - Backspace works also. Would you rather use the arrow keys?

Resp - Here again, it is what I'm used to. You use arrow keys in going back and forth in Enable. It isn't right or wrong, it's just different.

Nar - The resp. is looking at the status report screen.

Resp - This kind of stuff, I like that. That really jumps off...

Rschr - You like the highlighting of the text there.

Resp - Yes. How would you print it?

Rschr - You would use a Control G or something like that, or shift printscreen.
Resp - Why couldn't they put a print in the menu? Here again in some of the other common programs, one of the options is always print.

Task 1B

Nar - The resp. is at the status report of the element in question from task 1A.
Resp - How do you go back to a previous screen?
Rschr - You can in some, but not in this case. You would have to use the next key element option.
Nar - The resp. pushes the cumulative performance option and that graph and menu is displayed.
Resp - I really think like here (points to menu), if this was highlighted in a different color, it wouldn't run in with status. I would then print it.
Rschr - No, your on the cumulative performance chart. You want variance trends. Do you find that menu grabs your attention more than that title does?
Resp - Ah no, it's just stupidity that got me that time.

Task 1C

Nar - The resp. is still viewing the variance trends chart from the previous task.
Resp - Zoom and expand are physical things aren't they? They have nothing to do with estimating. Indices, I don't understand what they are.
Nar - The resp. presses the indices option and the option with the desired result is displayed. The resp. then presses the zoom option.

Task 2A

Nar - The resp. is at the previous task screen which shows the zoom screen from task 1C. The resp. chooses the key element option to find the element needed by the scenario. The resp. then accomplishes the task by printing the status report.

Task 2B

Nar - The resp. is at the point in the program where the previous task left off. The status report is displayed. The resp. proceeds to the variance trends screen where the menu is displayed.

Rschr - Now how do you show only the last six months?
Resp - Adjust... or expand... or zoom... I don't know what that one does... status. See, none of those makes sense. You would want a reduce, not an expand.
Rschr - If you want to focus on the last six months instead of twelve, which one of those options would work?
Resp - Well, it has to be that one I guess (the status option). It seems to me none of them makes sense. Can I come back to this easy?
Nar - The resp. tries the status option and goes off track for a few minutes until returning to the variance trends screen. The resp. then attempts to use the documentation.
Resp - Oh !@#$%, lets just try it.
Nar - The resp. chooses the indices option, and again has to work back to the variance trends screen and associated menu.
Resp - That is one of my comments then. To me, reading it like this without knowing it... it seems like there should be... it isn't intuitively obvious which you use to display the last six months.
Nar - The resp. tries the adjust option and nothing changed. The resp. then tries the zoom option and completes the task.
Rschr - You don't think zoom is intuitively obvious?
Resp - No... Well, I guess now that I know that is the one, I guess that is logical.
Rschr - Maybe they should have an option titled the "last six months."
Resp - No, then it would be cluttered. I would say, they should spread this out a little more (Resp. refers to the menu on the variance trends screen), wether you use color or not. They are just wasting space out here, why not use it?

Task 3

Nar - The resp. starts from the variance trends screen from the previous task. The resp. chooses the overview option and the overview screen and menu is displayed.
Rschr - Which of these options will allow you to change the database?
Resp - I don't know if you want the utilities... what I think you should do is to go to the option that allows you to select the element you want. Then you'll have a menu that lets you add or modify it.
Nar - The resp. chooses the "select and element" option. The screen shows all of the elements.

Resp - I guess you can't go highlight the one... you have to put it in there. The resp. types the number in and the status screen is displayed.
Rschr - How are you going to change anything from there?
Resp - Hmm... it doesn't look like I will.
Nar - The resp. tries the "all element" option and then in a few minutes goes to the overview screen and chooses the "utilities" option, which is the correct path. The screen displays the text explanation of the utility functions as well as the menu for those options. The resp. tries the modify option and not seeing a way from there, chooses the "correct" option which is appropriate.
Rschr - Do you think they ought to get rid of "modify"?
Resp - To me, that is the one you would want to press if you wanted to change something. It is not necessarily a mistake.
Rschr - It is too close to the same meaning as correct?
Resp - Yes, it is not clear which does what.
Nar - The resp. uses the arrow keys to locate the mistake and corrects the amount as the scenario requested. The resp. then tries to leave the "correct" mode by pressing the key that displays the menu. The resp. then tries to use the arrow key.
Resp - It doesn't work in that one.
Rschr - Do you thing that the same method should be used to move around?
Resp - Yah, I would think consistency is something good.

Task 4

Nar - The new task is begun at the same screen as the last task left off from. The menu on the spreadsheet is displayed. The resp. chooses the "add new element" option and enters the information the program calls for. The program then displays the name of the element as it always does at this point. There is no space between the name and the resp. wonders if there was a misspelling. The resp. is told about the bug and proceeds by answering yes to the posed question.
Resp - So now we just need to put in the rest of the figures.
Rschr - Lets see if the new element name is displayed.
Resp - No it's not. What happened?
Nar - The resp. brings up the menu and chooses the "finished" option. The spreadsheet then initializes and displays the element just entered.
Resp - It asked if I was done and I answered yes. It should tell you to go back to this screen (utility explanation) if you need to.

Nar - The resp. then enters the appropriate numbers and finishes the task.

Scale

Q #1 - The contrast with the background is good overall except with the menu. They should highlight that with color.
Q #2 - The same comment applies to overall use of color.
Q #3 - I didn't use it so I have no comment.
Q #4 - The feedback from the messages... what I saw was fine.
Q #5 - The overall screen layout was fine except for a couple of menus that I thought were too close together and that was a little bit confusing for the uninitiated, but other than that is was fine.
Q #6 - The graphics were fine.
Q #7 - Compared with enable, this is more cumbersome. No matter where you are, you can go back to the last screen. Compared with that, this is average.
Q #8 - It is not terrible, but it is not good either.
Q #9 - The written documentation looked alright for what I looked at it. I would prefer a more detailed index in the back.
Q#10 - Pretty good.
Q#11 - That is fine I guess.

Closing Comments

Q #1 - No, not even from the Air Force.
Q #2 - Some word processing, viewgraph and database work.
Q #3 - About 20 minutes.
Q #4 - Maybe.
Q #5 - I don't know if this would be useful, but people tend not to read things. They don't have time, especially in our place. Some applications have 10 minute guides to tell how to use something. It is like a three page pamphlet or something. It's like anything else, people are not going to read the detailed instructions, especially in a case like this where it is menu driven to a large extent. They will just experiment because it is easier to do it that way and they will learn it by going ahead and doing it. If you had a real simple guide with just the basics, it might help.

Transcription CAPPS G

Task 1A

NAR - The resp. has just chosen the key element option from the overview screen.
Resp - We can see which element has the largest cost variance.
Rschr - We need to print a status report of that.
Resp - Hmm spacebar....
Rschr - You just went to a different element.
Resp - Oh ok, I understand, I see where we are at. The white shows us what element we are looking at. We would want to print this.
Rschr - No, your on the right element, but you want to find the status report.
Resp - Oh, that is our status report. Print it.

Task 1B

NAR - The resp. is at the point in the program where the status report of the task 1 element is on the screen.
Rschr - The next thing you want to do is print a graphical chart showing the variance trends. That is your menu on the bottom. You just moved across the screen with the space bar.
Resp - The next key element, lets see what that does for us.
NAR - Resp. realized that option would not work.
Resp - Cumulative performance, lets see what that does for us.
Nar - The resp looks at the cumulative performance screen menu and associated screen.
Resp - This is what we are asked for, the variance trends.
Rschr - Your on the cumulative performance chart. You want to do the variance trends.
Resp - How do you know which one is shown?
Rschr - Here is a question for you. Do you find the bracketed menu item strikes your eye more than the chart title?
Resp - No, the brackets don't jump out at me. I assume now... I notice the brackets now, but before I didn't. I guess now this tells me I would be selecting the variance trends, but since it is the same color as everything else, it doesn't really jump out at me. In fact if you didn't notice, I was kind of fooling around because I didn't know where I was at. Here I can see that this is the cumulative performance and this tells me what has been printed out on the screen. Now I was looking for variance trends and I didn't even notice it down there. I

think it would be helpful if it were color coded, just like the graph, where if things are not selected, they are one color and the option about to be selected is another color.

Nar - Resp. presses variance trends option and the screen is displayed.

Resp - Now this is the part we are looking for.

Task 1C

Nar - The variance trends screen is still displayed for the element we are interested in.

Resp - We are looking for estimates. Lets see what we got to play with down here.

Nar - The resp. presses the overview option and then the status and cumulative performance options for the whole LRP program.

Rschr - Your now looking at the whole program and your little element is gone.

Resp - Oh, we got out of it somehow. Your right, we'll go back there.

Nar - Resp finds the EAC screen.

Resp - This is friendly. Obviously I haven't read the manual in depth... it is user friendly.

Task 2A

Nar - The resp. proceeded to the key variance screen and chose the appropriate element.

Resp - We need the status report and here is the status report.

Task 2B

Nar - The resp. has just finished task 2A and the screen shows the status report. The resp. goes one screen past the one that is desired.

Resp - Can I go back to the last page?

Rschr - Once you pass it you can't go directly back.

Resp - I think that is....

Rschr - Would you like the option of going back to the previous page?

Resp - Oh yah, sure.

Nar - The resp works around from the beginning of the process to the screen that is desired.

Rschr - Now your at variance trends again, how can you make it show just the last six months?

Resp - Maybe we could use zoom.

Nar - The resp. uses the zoom option and completes the task.

Task 3

Nar - The resp. went looking for the option to change database entries in the element report options before going to the database utilities option. The screen that explains the database functions is displayed.
Rschr - You want to correct an error, so which one of those things should you choose?
Resp - Modify or....
Rschr - Are the terms modify and correct confusing?
Resp - No. Not after you read it all. I can see where it might be confusing to some people.
Nar - The resp. uses the "correct" option listed on the menu. The spreadsheet is displayed.
Rschr - What did you do to make that beep?
Resp - I hit the space bar to try and move over.
Rschr - You just hit the space bar, what would you normally hit using a spreadsheet?
Resp - The cursor or arrow keys.
Rschr - You went from one way to another. Would you prefer they were all the same?
Resp - Consistency, yah when you use a spreadsheet, the arrow keys always move you around. We have been using the space bar. My first impulse was to try and move over so I went to the space bar... That is when I got the error. I think we should be consistent as to how we move around.
Nar - The resp. hit a key and the program beeps.
Resp - Unknown function, press return to continue. I wonder if I could...
Nar - The resp. corrects the cell as one normally does on a spreadsheet.
Rschr - What did you do to make the noise?
Resp - I hit this key.
Nar - The resp. was trying to display the menu like the screen suggested, but hit the back slash key instead of the slash key.

Task 4

Nar - The resp. is at the previous task screen and chooses the "finished" option. The database function screen is displayed. The resp. reads them all and can't decide. Finally the resp. chooses the "correct" option.
Rschr - Would you prefer they had this better explained on the screen?
Resp - Yah, I think you lose track. I had.
Rschr - How would you add a new element?

Resp - Use this key to display menu is the first thing I would do.

Nar - The resp. presses the key that shows the menu. (The backslash key was pressed first and then the correct "slash" key). The resp. then presses the add new element option and adds the information from the scenario when asked by the screen prompts. The system then displays an are you sure message with the name of the new element. The element name appears to be misspelled.

Rschr - Does it look like you misspelled integration?

Resp - Yes.

Rschr - You didn't. It is a bug in the system and it does that to everybody. It displays the system name right next to the message without any spaces.

Nar - The resp. presses the "yes" option and fills in the rest of the required data.

Scale

Q #1 - Option selections at the bottom of the screen should be color coded.

Q #3 - Some definitions need to be more clear cut.

Q #8 - Movement controls are not consistent. Sometimes the spacebar is used and then at other times the arrow keys are used.

Closing Remarks

Q #1 - Oh ya, computer science, microprocessors, and Pascal, Ada, C, assembly, and basic programming.

Q #2 - Yes, every day. Wordprocessing and viewgraphs.

Q #3 - Not at all.

Q #4 - Very relevant.

Q #5 - I think the program has great possibilities. I think overall the system is friendly, very friendly, it's flexible. I think it needs to be more uniform, more consistent in how you move. I think some of the options need to be better defined and clearer cut, such as the modify and correct options. I think they may confuse users until they get used to it or it is going to be geared towards a specific group that only work in that environment.

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This research reviewed and validated important requirements for the design of an effective human/computer interface. The requirements were derived from expert opinion found in literature and then many of the requirements were validated by protocol analysis.

Fourteen participants, all ASD personnel, tried working scenarios using two modules of the Program Manager's Support System. Their comments were collected, as was an opinion scale, and the data was analyzed.

The participants' comments and opinions followed closely with that of the experts in the literature. This study should benefit ASD in their evaluation of this system and it should provide the system developers ideas for program enhancement.